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APACHE VS. THE TALIBAN

Pilots Who Flew Into H-Bomb Blasts p.30

Self-Healing Airplanes

INSIDE THE SECRET SPACE SHUTTLES

One Small Airport That Beat The Wrecking Ball

AUGUST 2009

How's This For a Stimulus Package?

FREE Ruby Pendant for the First 2500 Responders

Our gift to you: A one carat radiant, lab-created ruby pendant

Here's some important news that will affect your bank account. But it's good news, for a change. You see, while Congress was busy cutting billion dollar checks to the banks and big corporations, we concocted our own bailout plan. And ours won't cost the taxpayer a dime and looks a million times better with a cocktail dress.

In tough economic times, it's just not good enough to offer meager discounts of 10% and 20%. Even "half-off" has become ho-hum. That's why we're going all the way. Our stunning *Scienza*™ lab-created ***Ruby Pendant*** can be yours for **FREE** (You pay nothing except basic shipping and processing costs). Similar designs can be found at the largest jewelry stores in America for $299. But for a limited time, **you can take 100% off!**

This is no joke. There is no catch. Simply call our toll-free number or log on to **www.stauer.com**. The first 2500 to respond to this ad will get the *Scienza*™ lab-created ***Ruby Pendant*** absolutely FREE. If you're wondering exactly how we can afford to do this... read on.

Why give away jewelry? Our real goal is to build a long term relationship with you. We are convinced you will become a loyal Stauer client in the years to come. But for now, in this lousy economy, offering this remarkable pendant seemed the best way for you to give us a try.

The *Scienza*™ ***Ruby Pendant*** features an impressive 1-carat oval-cut, lab-created ruby prong-set in luxurious gold vermeil. Surrounding the radiant red oval are 14 brilliant-cut, lab-created Diamond*Aura*® dazzlers. The combination sparkles with a passionate fire that is even brighter than most mined stones.

The world's most valuable gemstone. For thousands of years, the luxury of natural rubies has been coveted by pharaohs, emperors and royalty from all continents. Known as the "king of all precious stones," the red glow of a ruby symbolizes love, life and desire. But such beauty can come at a steep price and even today, rubies remain some of the most expensive gems on Earth.

Can science really improve nature? The right chemistry is vital in any romantic relationship. We had to get it perfect. That's why the gemologists worked for years to create the world's most romantic, most colorful lab-created ruby. Our *Scienza*™ are scientifically grown, crafted in laboratories with precise equipment that recreates the high pressures and heat that nature uses to produce gemstones far beneath the surface of the earth. *Scienza*™ are chemically identical to the natural gemstone in hardness and display a better color and sparkle than most mined corundum.

But mined rubies can cost up to $5,000 per carat for this level of color and clarity! The *Scienza*™ originates from an ingenious process that lets you experience the seductive fire of priceless gems without the exorbitant cost. You pay nothing except basic s hipping and processing costs of $25.95, the normal shipping fee for a $200–$300 pendant

It's okay to be skeptical. But the truth is that Stauer doesn't make money by selling one piece of jewelry to you on a single occasion. Our success comes from serving our long term clients. Be one of the first 2500 to respond to this ad and receive 100% off while getting a closer look at Stauer's exclusive selection of fine jewelry.

JEWELRY SPECS:

- 1 carat 5mm x 7mm lab-created, oval-faceted ruby
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Smart Luxuries—Surprising Prices

Brian Grote is a flight instructor with years aviation experience. He also writes monthly columns on subjects pertaining to aviation.

FLYBY

ARTICLE WRITTEN BY: BRIAN GROTE

Dear Brian,

I've been flying for over 20 years. My usual run is a Denver departure at 9pm, fly to Billings, on to Cheyenne and then back to Denver by 5am. I fly a King Air 350. I love my career and I pride myself on doing the best job I possibly can.

Last time out, however, I was making lots of little mistakes. I was cleared for the ILS Runway 35R into Denver, but I couldn't pick up ATIS. That's when I looked at my radios and noticed I had dialed in the wrong frequency. I glanced again and dialed in the right frequency. I continued through my checklist and set my Radar Altimeter to 5500 feet. I was ready to make my descent and start my approach. After the outer marker I glanced at my DH again and noticed that I had set my Radar Altimeter, 67 feet low. Luckily, I landed safely, bouncing the wheels just a little.

After a couple more days in the sky I could tell my eyesight was beginning to deteriorate. I knew I wouldn't be able to renew my first class medical if I didn't do anything about it. I was really worried and started asking my peers if there was anything I could do. A co-worker gave me a bottle of Claroxan™ and told me it would help me maintain my depth perception. I was skeptical at first, but tried it anyway. As it turns out, the stuff works great. The problem is, I ran out and don't know where to find more. Have you heard of this Claroxan™ stuff? Is it available in the States?

Jason, 46 – Seattle, WA

Jason,

Not only do I know of Claroxan™, it just so happens I take it everyday. Being a pilot myself, I know that perfect visual acuity is an asset none of us can afford to lose. That's why every pilot should be protecting their eyesight before it's too late.

Claroxan™ contains ingredients proven beneficial for the eyes. Among these ingredients are lutein and zeaxanthin – powerful antioxidants that have been clinically proven to protect the retina and macula and, in some cases, reverse the damaging effects of macular degeneration. These antioxidants block damaging UV rays and halt damaging free radical oxidation in the back of the eyes. They have also been clinically proven to decrease the risk of cataracts.

Claroxan™ also contains bilberry, an antioxidant known to improve night vision. Bilberry's night vision enhancing effects were first noticed in England in the early 1940's. The RAF ordered English fighter pilots to eat bilberry jam on toast figuring it would give them an advantage during night raid missions against the German Luftwaffe fighters.

Claroxan's unique proprietary formulation is completely safe, all-natural and extremely affordable. As far as ordering it, you can call them toll-free at 866.775.3937, or go to www.claroxan.com. I usually get mine within a week after ordering.

Hope this helps!
Brian

THE Himalayan CATARACT project

The Himalayan Cataract Project strives to eradicate preventable and curable blindness in the Himalayas through high-quality ophthalmic care, education, and establishment of a sustainable eye care infrastructure.

Based in Asia, at Kathmandu in Nepal, the Project is empowering local physicians to alleviate the suffering caused by blindness through unique programs including skills-transfer education, cost-recovery, research, and the creation of a world-class network of eye care facilities.

In years past, PacificHealth donated a portion of profits to HCP for development and construction of eye facilities in the Himalayas.

Visit CureBlindness.org to learn more about HCP.

CLAROXAN™ | LEADER IN VISION IMPROVEMENT

Sunlight, aging, and diet each cause damage to the retina and macula, which can lead to a decline in vision that glasses or contacts can't help. If you've experienced an increase in blurriness or have difficulty seeing details at any range, then you know how valuable sharp vision can be. What you might not know is that in the past three years, a flood of new scientific research has been done on natural vision enhancement. This medical research suggests that ingredients in Claroxan™ may help maintain and even improve your vision, while at the same time giving you added protection against many ocular diseases

Claroxan™ may improve macular pigment density, which research shows has amazing effects on vision. By improving macular pigment density, ingredients in Claroxan™ may improve normal visual acuity, contrast sensitivity, and even glare reduction. Participants in one clinical study reported that ingredients in Claroxan™ improved their long range vision outdoors – in some cases, they were able to distinguish far away ridges up to 27 miles further than normal! Even if you have perfect vision now, Claroxan™ may help give you an edge by improving your visual reflexes and may allow you to pick up on moving objects faster than ever before.

People who count on their vision – people like pilots, hunters, military, and even pro athletes – trust Claroxan™ as the best source available for vision enhancement and protection. Claroxan™ is safe, effective, and extremely affordable. However, people with serious health concerns should consult a doctor before use.

One Giant Leap for Eye Protection

Eagle Eyes® Apollo Gold™ sunglasses are quite simply the most advanced eye protection ever created

Spacewalking astronauts don't care about designer labels. You can't be concerned about fashion when floating 186 miles above the Earth, hurtling through space at 10 times the speed of a bullet. It's much more important to know that your equipment is up to the job.

Even though a mission to repair the International Space Station seems more dramatic than a morning commute, your personal safety is no less important. That's why Eagle Eyes® is proud to introduce the advanced **Apollo Gold**™ optical sunglasses, developed from original NASA Optical Lens Technology.

Unfiltered direct sunlight has always been a problem for test pilots and astronauts. That's why, to protect their eyes, their faceplates require the most advanced optics ever invented.

Eye-protection inspired by nature. Plenty of companies make aviator sunglasses, but few understand aviation like NASA. From microchips to GPS, NASA's team of scientists have been behind some of the greatest technological advances of the last 50 years.

NASA scientists looked to nature for a solution to eye protection which led them to their studies on how eagles can simultaneously distinguish their prey from their surroundings with utmost precision, while protecting their eyes from sunlight.

Who Better to Know About the Best UV Eye Protection than America's Astronauts?

"I have worn the EAGLE EYES® brand for years and depend upon their superb capabilities in UV eye protection, glare reduction and vision-enhancement."

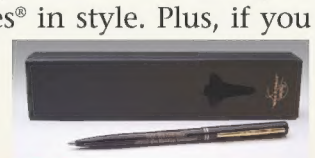
— WALTER CUNNINGHAM, APOLLO-7 ASTRONAUT

NASA scientists independently replicated this same technology into Eagle Eyes® **Apollo Gold**™ optical sunglasses, serious sun-protection that offers **12 distinct performance levels** in a single lens. Eagle Eyes® **Apollo Gold**™ patented, polarized lens technology was tested to enhance vision while protecting from the sun's harmful UVA, UVB radiation and blue-light.

Developed from Original NASA Optic Technology, EAGLE EYES® is the ONLY Sunglass Lens Certified by the SPACE FOUNDATION for UVR & Blue-Light Protection

Unparalleled clarity. With their patented triple filtering system, Eagle Eyes® reduces the blinding glare you may encounter while driving or enjoying outside activities. This technology produces unparalleled visual clarity, contrast and definition and blocks the harsh UV light while enhancing the colors of your environment. All of this with a "no smudge"/no fingerprint oleophobic coating.

The Eagle Eyes® **Apollo Gold**™ frames feature an aggressive ergonomic design with 2X scratch-resistant coatings, affording maximum durability while maintaining crack and impact resistance. You will also receive one soft zipper case and a micro-fiber cleaning pouch & cloth with anti-fog cleaner so you can carry and protect your Eagle Eyes® in style. Plus, if you are not thrilled with the Eagle Eyes® **Apollo Gold**™ technology, simply return them within 30 days for a full refund of your purchase price.



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Departments

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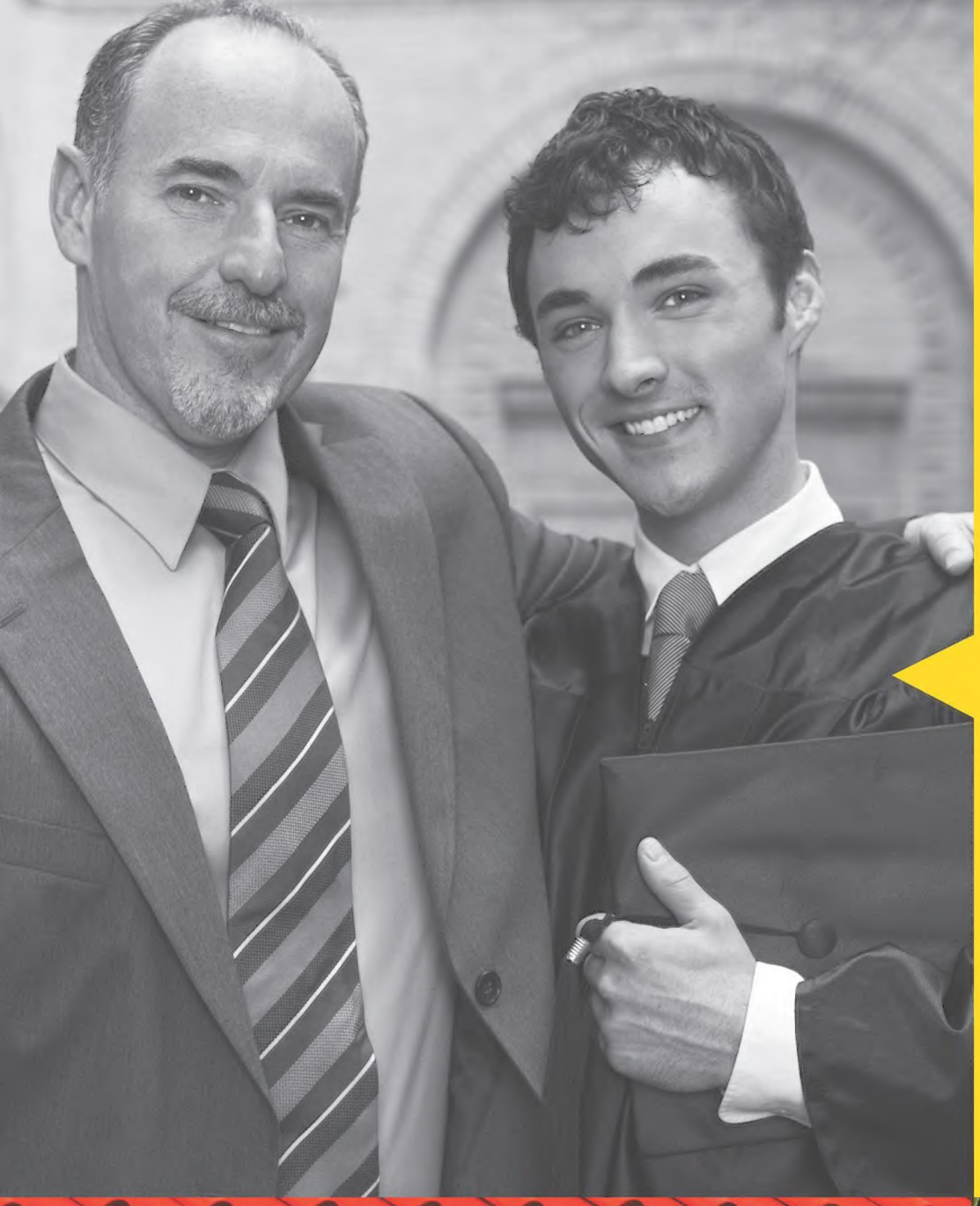
If you were one of the 400,000 who worked on the Apollo program – or a family member of one – we have a place for you. Visit the Web site; tell us your story. If you were not part of that extraordinary labor force, visit the Apollo special section to learn about it.

ON THE COVER: If you are not a friend of the British, this is not the view you want of the Apache AH Mk.1 attack helicopter, photographed on a training exercise by Sean Clee in Devon, England. Learning to fly the beast "was the hardest thing I've ever done," says pilot Ed Macy (p. 36).

Features



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Viewport

FROM THE DIRECTOR

Galileo's Legacy

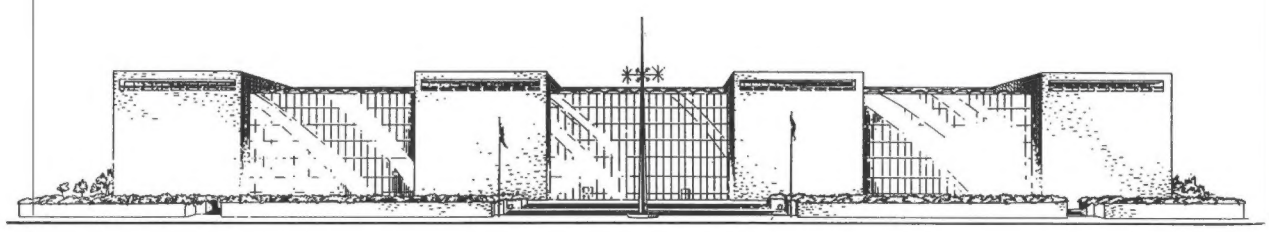
PEOPLE ON EARTH have been peering at the sun, moon, planets, and stars since before recorded time. But only in the last 400 years have we exploited the ability to see other planets as worlds, all very different, yet far more like Earth in substance and form than had been believed before they were seen through a telescope. It's not a stretch to claim that when we first started using telescopes as an aid to vision, not only did distant objects become closer, but Earth became part of a whole new physical universe.

This year is the 400th anniversary of the first time someone, an Italian mathematician known as Galileo, used a telescope to view the heavens. We are able to mark the occasion because he wrote down his observations, sketched detailed visual impressions, and, most important, took the effort to spread what he saw far and wide in provocative, engaging, and convincing published works. Accordingly, the world body of astronomers, the International Astronomical Union, proposed that this year be celebrated as the International Year of Astronomy, or the IYA, a designation endorsed by the United Nations and by more than 100 countries.

The central elements of Galileo's efforts—exploration, discovery, and education—all factor in to the anniversary, and are reflected in the mission of the Smithsonian and its National Air and Space Museum. We have dedicated all of our 2009 astronomy outreach activities to the themes of the IYA. The year's space lectures have all taken on IYA themes, and we have been expanding our exhibits and offering Family Day themes on astronomy and the IYA. Most exciting, we are now building the first observatory on the National Mall for free daily public viewing. With a full-time staff of two astronomy educators and a growing force of interns, volunteers, and explainers, the experimental Public Observatory Project—POP, as we call it—will offer visitors the chance to view the sun, moon, and the brighter planets during daylight hours, weather permitting.

Although the observatory will bristle with modern electronic means of enhancing what is out there, and it will be connected to a worldwide network of observatories viewing the heavens during the IYA, the special treat is the chance to peer through the eyepiece of a professional 16-inch telescope, borrowed from Harvard University. Anyone who walks in will be treated to the chance to collect some personal photons from the depths of space, whether they have been reflected off the moon (travel time 1.5 seconds), radiated by the sun (8 minutes), reflected from planets (minutes to hours), or emitted from stars (years, centuries, millennia). The POP will be a center of inspiration and educational adventure and a starting point for our millions of visitors, who will be given a chance to better appreciate where we are and how we fit in this vast universe we inhabit.

J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.



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Air & Space/Smithsonian; August 2009; Vol. 24, No. 3

Air & Space/Smithsonian *will publish an extra issue in September 2009. Subscribers will still receive 6 or 12 issues as part of their paid subscriptions; however, membership expiration dates may move.* *Air & Space/Smithsonian* (ISSN 0886-2257) is published bimonthly by Smithsonian Enterprises, MRC 513, PO Box 37012, Washington, DC 20013-7012. Periodical postage paid at Washington, DC, and additional mailing offices.

POSTMASTER: Send change of address to *AIR & SPACE/Smithsonian*, PO Box 420113, Palm Coast, FL 32142-0113. Printed in the USA. Canadian publication agreement no. 40039324. Canadian return address: Brokers Worldwide, PO Box 1051, Fort Erie, ON L2A 6C7 Canada.

Editorial offices: MRC 513, PO Box 37012, Washington, DC 20013. Circulation and advertising offices: 420 Lexington Ave., New York, NY 10170.

Subscription Prices: U.S. and possessions: $26 a year payable in U.S. funds. Canada and all other countries: add $6.00 (U.S. funds) per year. Ninety-nine percent of dues is designated for magazine subscription. To purchase an issue (current $4.99, back issue $7), please write *AIR & SPACE/Smithsonian*, 420 Lexington Ave., Suite 2335, New York, NY 10170, or call (212) 916-1379.

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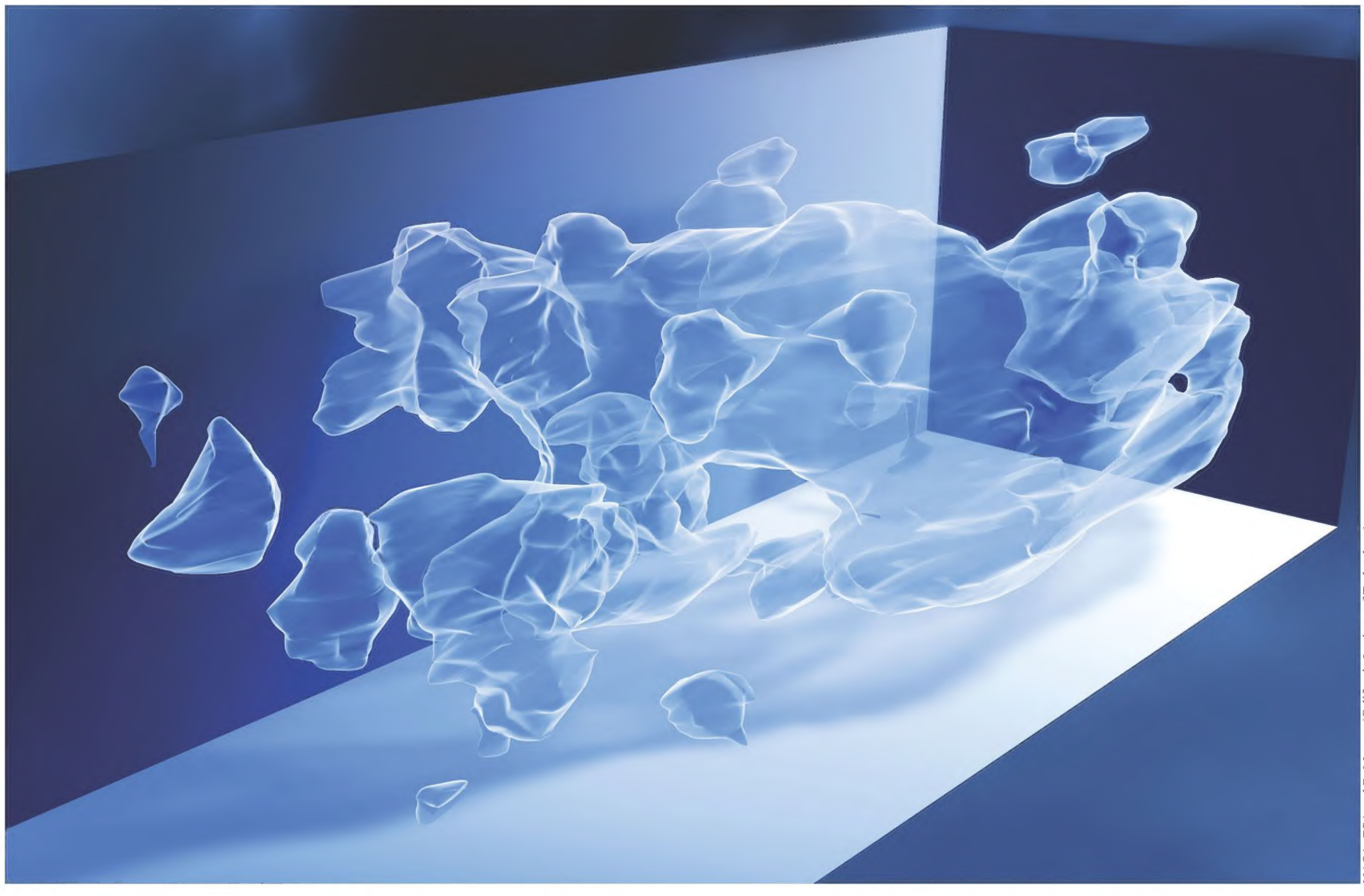

NASA, ESA and R. Massey (California Institute of Technology).

What is the Universe *Really* Made Of?

In recent years, scientists have discovered that 95 percent of the contents of the cosmos is invisible to all current methods of direct detection. Yet something is definitely there, governing the shape and fate of our universe. These phenomena, called dark matter and dark energy, are the most eagerly studied subjects in astronomy and particle physics today. And for good reason—What could be more exciting than cracking the mystery of the fundamental components and composition of the universe?

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Letters

WRITE TO US

Flight 1, Take 2

In response to Commander Ray Ross' story (Letters, June/July 2009), the first flight of the A2F-1 was made by Bob Smyth, not me. I didn't fly the aircraft until several days later, after it had been checked out by our mechanics and engineering experts after its first flight.

I also never flew in a business suit. I always had my Navy flightsuit on, and under that my G-suit, in case I needed to pull Gs. In addition, during my flight training, many instructors made it very clear that a safe pilot never flies without having his seat belt and shoulder harness as tight as he can stand it, to protect him in the event of a crash.

Corky Meyer
Ocala, Florida

An Aerobatic Bomber?

"The Dawn of Discipline" (June/July 2009) brought to mind a sight that astounded me. I was assigned to the Air Force Armament Center at Eglin Field in Florida. Every year the AFAC had a Fire Power Demonstration for visiting military officials, House and Senate members from Washington, D.C., and other dignitaries. Prior to the demonstration, several types of aircraft would make practice passes over the main part of Eglin Field.


The Dawn of DISCIPLINE

A B-47 PILOT REMEMBERS WHEN AN AIRPLANE – AND CURTIS LEMAY – STIFFENED THE SPINE OF THE STRATEGIC AIR COMMAND.

BY WALTER J. BOYNE

I GOT MY FIRST GLIMPSE of a Boeing B-47 on an April morning in 1954, when I was a U.S. Air Force first lieutenant with about 450 hours in bombers. I was waiting out to fly a rather staid base aircraft, a Beech C-45, and saw the B-47—glittering in the Cal-desert sun and trailing long plumes of exhaust—land at my home station, Castle Air Force Base, the first of the 45 to be assigned there.

As a young pilot, Walter J. Boyne couldn't wait to fly the U.S. Air Force's hot new bomber: the swept-wing, jet-powered Boeing B-47 Stratojet.

A member of my squadron told me he had seen a B-47 make a toss-bomb maneuver and that on practice day I should watch for it. I questioned him, suggesting that he must have had the aircraft designation wrong; I strongly doubted that a B-47 could make such a maneuver. The aircraft was too big and heavy, and the wings were too long and flexible to support the aircraft weight.

The practice day arrived, and around noon I saw a B-47 fly over Eglin Main, pull up into a vertical climb, roll over from an inverted position at the top of the climb, and fly away in the opposite direction. What a thrill! The entire maneuver looked so smooth and easy, as though this was an everyday maneuver for the B-47. I was very surprised, and full of apologies for my fellow airman.

Robert M. Wilson
Wakefield, Rhode Island

Blight of the Intruder

"Unmanned Traffic Jam" (June/July 2009) reports that Virginia Tech professor David Schmale deliberately infected a potato field with potato blight, then let the spores spread through the atmosphere. The article states that the organism can travel hundreds of miles and that potato crops have limited defenses against it. So this spore, which once devastated Ireland, is spreading to other potato plots? Tell me it isn't so.

Bob Wilbur
via e-mail

David Schmale replies: Our small experimental plots were located at a research farm that is more than 100 kilometers [62 miles] from any commercial potato fields. The epidemics were managed during a short period (days) and the weather was warm and sunny, which greatly reduces the viability of the water-loving sporangia.

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U.S. GOV'T GOLD AT-COST

TODAY - The United States Rare Coin & Bullion Reserve has scheduled the final release of U.S. Gov't Issued $5 Gold Coins previously held at the U.S. Mint at West Point. These Gov't Issued Gold Coins are being released on a first-come, first-serve basis, for the incredible markup-free price of $124 each. This "at-cost" Gov't Gold offer could be cancelled at any time. Do not delay. Call a Sr. Gold Specialist today.

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Letters

Beyond the Bullet

After John Glenn's transcontinental flight ("Project Bullet," Moments & Milestones, June/July 2009), his F8U Crusader was assigned to the Navy's Light Photo Reconnaissance Squadron 62 (VFP-62). It was flown on several low-level missions over Cuba during the 1962 Missile Crisis.

Lieut. Cmdr. Tad Riley
U.S. Navy (ret.)
via e-mail

Glenn's F8U was lost in December 1972. Lieutenant Tom Scott was on final to land it aboard the USS *Oriskany* when he was involved in a ramp strike. He ejected and was recovered, and the airplane continued down the flight deck, then went over the side and into the Tonkin Gulf. (I was aboard the *Oriskany* in another squadron when the loss occurred.)

Roger D. Scott
Slippery Rock, Pennsylvania

Face to Face With the Flying Wing

I was at Andrews Air Force Base in Maryland on February 9, 1949, and saw the Northrop YB-49 Flying Wing land. I was a wet-behind-the-ears second lieutenant, less than a year out of aviation cadets. I asked permission to climb aboard, and if memory serves correctly, it was Major Robert L. Cardenas, whose story is recounted in "Too Much, Too Soon" (Above & Beyond, June/July 2009), who granted me permission to climb into the cockpit. I'm sure I looked at the crew of the Flying Wing as if they were Martians in a flying saucer.

Later, the Flying Wing made a local flight for President Truman as a demonstration of air power. I too was aloft at the time, a standby pilot in a spare P-80 in case anyone in my squadron had to abort before taking part in a flyby. I remember climbing to 10,000 feet and circling left over Andrews Field. Suddenly, I got the feeling I was not alone. I looked ahead, and there was the YB-49 in the midst of a turn in the opposite direction that was putting us on a head-on collision course. I remember seeing the Flying Wing's flaperons or spoilers opening up, probably so the craft would avoid hitting my aircraft. I quickly banked my P-80 in the opposite direction and pulled Gs, then hastily left the area. It had been close, so close I thought it might be prudent to disappear for a while.

From then on, I always remembered what my mother taught me: "Don't stare!"

Major Roy C. Ihde
U.S. Air Force (ret.)
Green Bay, Wisconsin

Corrections

June/July 2009 "Travels with Churchill": (1) William Vanderkloot logged a million miles since he began flying in the late 1930s, not in the 18 months in which he flew for the Ferry Command. (2) The photograph on p. 28 shows Winston Churchill next to his daughter Mary, not a soldier. (Reader Jeffrey Shirhall tells us that Mary had been assigned to an anti-aircraft battery in London, and that in this 1944 photograph, the two watch the battery directing fire at a German V-1 rocket.)

WRITE TO US at Letters, *Air & Space/Smithsonian,* MRC 513, P.O. Box 37012, Washington, DC 20013. Please type or print clearly. You must include your full address and daytime phone number.

e-mail: *editors@si.edu*. All e-mails must include your full name, mailing address, and daytime phone number.

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According to scientific research, people can listen to a brain-fitness computer program to help rebuild brain matter that has turned flabby with age. Their findings indicate that the brain can reshape itself based upon the data it receives from a person's thoughts.

Richard W. Wetherill
1906-1989

Taking action that lets the brain *grow* has appeared in our advertising for more than a decade, informing readers of the wrong data that "*flabs*" the brain, and leaves people out of touch with reality.

The method for releasing the brain's wrong data was explained by the late Richard W. Wetherill in his book, ***Tower of Babel***, published in January 1952. He called the wrong data ***distortions of logic***. He explained why and how distortions of logic are formed, how they affect the brain and subsequent behavior, how they are released, and the resulting transformation of a person's relationships, intellect, and health.

It is commonly thought that the brain is the body's computer, receiving data and acting on it accordingly. Wetherill defined the process as *right thinking causes right results, whereas wrong thinking causes wrong results.*

People's brains function that way because ***whoever or whatever is the creator*** provided natural laws to enable human beings eventually to evolve into the kind of beings intended by that creator.

Today, natural laws are known as laws of physics, but there is also a behavioral law identified by Wetherill. He called it the ***law of absolute right***. It states: ***Right action gets right results; wrong action gets wrong results***, and it defines right action as rational and honest responses to whatever happens.

As with all natural laws, our ***results*** tell us if we are conforming to the behavioral law or contradicting it.

Originally that was the most unpopular information ever presented to a society that, from the beginning, established the practice of blaming wrong results on other people, bad luck, and later on, life styles, faulty diets and inherited genes—almost never on self.

It is widely known that laws of physics make mandatory people's physical activities. Thus they learn not to touch live wires, not to speed across an oil slick, and that gravity keeps pedestrians tethered to the earth.

But, lacking the knowledge of nature's ***law of right behavior***, society still believes that suffering and even death are the inevitable plight of mankind.

There are well-meaning efforts being made to cope with those typical wrong results: charitable giving to help the needy, finding cures for diseases, and addressing famine and genocide overseas.

Our books and public-service advertising tell people how those problems could be *eliminated*. In the meantime, disinterest delays the breakthrough that theoretically will come when enough people learn to conform to creation's ***law of absolute right***.

As far back as the 1960s, behavioral experts declared this information too simplistic and unworkable while, at the same time, surreptitiously inserting parts of it into their own programs.

Do not be deterred by differing expert opinions. Learn about the behavioral law. Conform to it, not to benefit you (although it will) but to do what is right because that is what nature's behavioral law calls for. If that is your approach, you will be astonished by the results. If you are not astonished, be sure you are conforming to creation's law of absolute right with the same eagerness as you conform to creation's law of gravity.

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Text by E. Marie Bothe, President of The Alpha Publishing House.

The Branson Wave

>>> LAST TIME I FLEW out of Los Angeles International, did airport administrators personally wave goodbye? Let me think. No. But that was LAX and this is BKG—Branson, Missouri's new airport. "We call it the Branson Wave," says Gene Conrad, deputy director for marketing and air services. "When the planes depart, we all go out and wave goodbye. *Everything* is different here."

We're standing under a neon-blue Ozark sky, which moments ago included a Sun Country 737 climbing out. A prime destination for family entertainment, Branson has eight million annual visitors, who used to come and go on wheels, from mom and dad's mini-van to fleets of charter buses. Or, like me, a subcompact rented at Springfield-Branson National Airport, 50 miles north.

The $155 million Branson Airport has a homey look in its terminal (above), a mere four gates for airliners, and no jetways; passengers will deplane via rolling airstairs. And that, officials say, is just fine and dandy: "Everything is different here."

Public sector airport initiatives came and went too. Last May 11, it was the private sector that finally succeeded. Branson Airport LLC is the first and only privately developed and operated commercial service airport in the United States. No government funds support the facility, which is on 922 acres owned by developer Glenn Patch (and at one time by singer Tennessee Ernie Ford). Except for air traffic controllers and Transportation Security Administration personnel, everyone's employed by the airport.

Will herded, harried air travelers notice the for-profit difference? "Absolutely, as soon as they step off the plane," Conrad promises. "We have to operate like a true business, we have to treat people with respect, we have to make sure we do the right thing. It's not like we're a governmental entity." And native Bransoners can now blow off the high fares at Springfield and Northwest Arkansas Regional airports. "Locals have just been getting crushed by that," Conrad says.

Hushed between still-sparse arrivals, Branson's terminal has the ambience of an Ozark mountain lodge: beamed ceilings, rustic woodwork, rocking chairs in a waiting area. An old-time water wheel splashes soothingly. Paw prints of native critters—turkey, wolf, and deer—are etched into the floor, and an open-cockpit homebuilt hangs overhead.

So far, AirTran and Sun Country are the only airlines making use of the 7,140-foot runway. But Conrad hints at coming commitments from other low-cost carriers—even one serving Southern California city types like me. Maybe the "LAX Wave" is coming too. Or not.

STEPHEN JOINER

COURTESY BRANSON AIRPORT (2)

Chef's Special: Rocket Fuel

IF YOU'VE GOT a question about soil composition, you go to a soil scientist. If the issue concerns computers, you go to a computer scientist. And if the problem involves rocket propellant, you go to...an agriculturist?

That's the approach taken by a Purdue University team that has been commissioned by the U.S. Army to develop a rocket fuel in the form of a gel. "It's like orange marmalade without the rind," says team leader Steve Heister, a professor in the School of Aeronautics and Astronautics. "We talked with the food science people—they think about gels all the time."

Gelled propellants should be safer than liquid fuels, which are at risk of exploding. Unlike solid fuels, which burn until exhaustion, a gel could theoretically be throttled up and down—if somebody could figure out how.

The gel is a hypergolic propellant, which ignites when the fuel and the oxidizer come into contact. Gels are notoriously tricky to understand because they're what are known as non-Newtonian fluids. "Water is a very simple material because it has only one viscosity and no gelling properties," says Osvaldo Campanella, a Purdue professor of agriculture and biological engineering. "A hypergolic gel is more like peanut butter."

Just as peanut butter—or marmalade—is solid in the jar but can be spread on bread, the propellant is a gel when it's loaded in the tanks, yet behaves like a fluid when it's pumped through nozzles into a combustion chamber. Predicting what happens when the spray atomizes is a formidable problem that the team is studying with high-speed videography.

The Army's $6.5 million contract is scheduled to run for five years. After that, NASA may start asking its own rocket scientists what's cooking.

PRESTON LERNER

WORK NO LONGER IN PROGRESS

Bye Bye, Biplanes

AFTER 23 YEARS of rallying 'round the biplane and hosting an annual Biplane Expo at Bartlesville Municipal Airport in Oklahoma, the National Biplane Association has closed up shop. The December 2008 notification cited "the emotionally difficult decision" made in light of "the downward trend line of activity at the Biplane Expo, the ever greater costs" of the event, and "an acute awareness of emerging general economic decisions." Expo 2009, "The Grand Finale," took place the first weekend in June; around-the-world *Voyager* pilot Dick Rutan was the guest of honor.

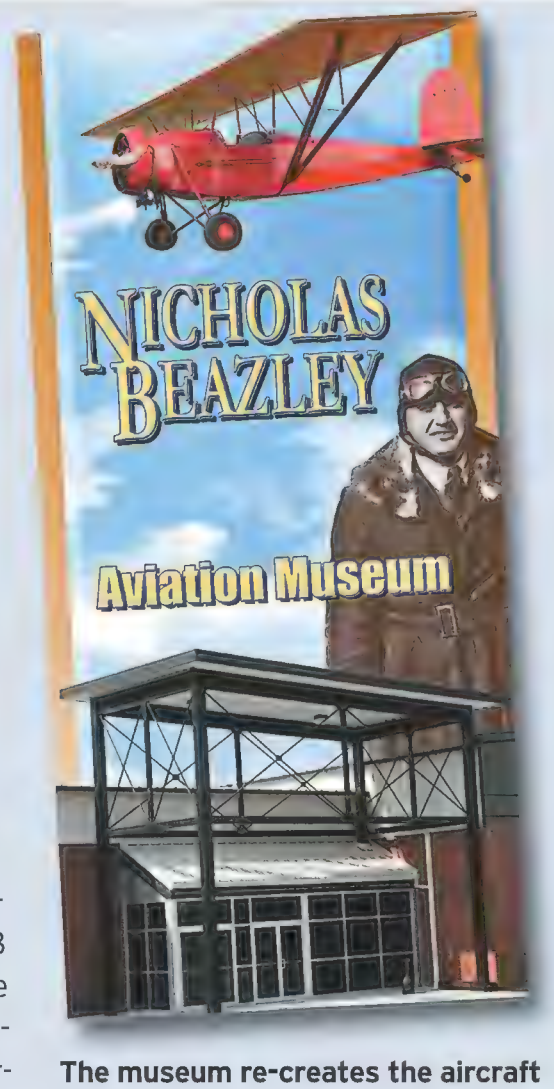
A Grand Finale attendee, a Stearman in "recall" livery was used in the days before air-to-air radio to signal student pilots to return to base when bad weather was closing in.

MUSEUMS

Marshall Brings Its Barling Home

IN 1924, RUSSELL NICHOLAS and Howard Beazley established the Nicholas-Beazley Airplane Company in Marshall, Missouri, on the site of Newell Farm, where, history notes, "it was necessary to clear the livestock off the runway." Three years later, having added a flying school and a parts warehouse, the two teamed with Walter Barling to develop the NB-3 (Barling) single-engine monoplane. In 1937, after the Great Depression, Nicholas-Beazley merged with Air Associates of New York.

Sixty-five years later, Marshall residents bought NB-3, registration no. 554M, from its Oklahoma owner and trucked it back to its birthplace. Having raised a total of $3 million, the Building the Vision campaign restored the aircraft, acquired a 1931 NB-8 trainer and a homebuilt Flying Flea, and built the Martin Community Center and Nicholas Beazley Aviation Museum, which opened this summer at Marshall Municipal Airport.



The museum re-creates the aircraft factory and flying school.

LEFT: COURTESY NICHOLAS-BEAZLEY MUSEUM; TOP: GILLES AULIARD

Starquakes

STARS AREN'T as twinkly as they seem. The turbulent convection in their hot stellar layers produces sound waves, which in turn set off shaking and vibrations. And just as the vibrations and tremors that travel through Earth during earthquakes provide a window into the internal makeup of the planet, stellar oscillations, or starquakes, reveal vital clues about the inner structure of stars. The field itself, called asteroseismology, is about to get a big shakeup, thanks to last March's launch of NASA's Kepler space telescope.

The primary job of the telescope, named for 17th century German astronomer Johannes Kepler, is to search for Earth-like worlds around other stars by detecting the incredibly faint dimming in brightness that occurs when one of those tiny planets passes in front of its parent star. The spacecraft's photometer can detect changes of brightness as slight as 80 parts per million—about the same sensitivity required to detect the tremors for asteroseismology studies. "If you build an instrument that can detect Earth-like planets, you've almost automatically built an instrument that in principle can do asteroseismology," says astronomer Ron Gilliland of the Space Telescope Science Institute in Baltimore, Maryland, who heads up the Kepler asteroseismology team.

Asteroseismologists first noticed oscillations in the sun in the 1960s. But the science had to wait for technology to catch up. "It's only with advanced, very precise instrumentation that you can measure such small oscillations on other stars," says Gilliland, "and it really was the 1990s before there were any results at all." Those results grew out of early searches for extrasolar planets, so from the start, asteroseismology and planet hunting have been linked.

Now Kepler promises to open a vast catalog of new data on the structure, size, and lifetime of distant stars. "The science of Kepler is also a complete survey of what's going on in that solar system," says Kepler chief engineer Riley Duren. If Kepler finds an Earth-like world, asteroseismology measurements of its parent star will yield further hints as to whether the system might actually be habitable.

MARK WOLVERTON

Cascade: You've Still Got Mail

WHEN THE U.S. Postal Service found itself owing nearly $6 billion this year, budget crunchers checked all expenses line by line and found one that didn't add up: $46,000 paid annually to Arnold Aviation of Cascade, Idaho, population 997. For mail delivery.

Every day for 34 years now (except in atrocious weather), Ray Arnold has patrolled 6,900 square miles of Idaho wilderness in his Cessna 185, delivering mail and supplies to as many as 100 customers (in summer) and as few as 20 (winter). In fact, Arnold is the sole pilot in the Lower 48 flying backcountry mail. The bean counters figured that the Postal Service could rent out post office boxes. But many of these customers live more than 50 miles—by trail—from Cascade.

"An airplane's the only way to do it," says Arnold.

Ray Arnold (above), dropping in with the mail, just like he's done for 34 years.

UPDATE

A Cuba Reprise?

AIR JOURNEY, which organizes worldwide tours for pilots, plans a four-day jaunt to Havana, Cuba ("The Country Where Nobody Flies," Aug. 2007), pending U.S. Department of Treasury approval. Air Journey's Thierry Pouille hopes to lift off from Miami, Florida, "before November," but paperwork – and the 2009 hurricane season – may cause delays. The $2,845-per-person cost covers nearly all expenses, right down to a shirt embroidered with the pilot's name and aircraft registration number. Note: BYOA (Bring Your Own Airplane). Highlights include meetings with specialists from Civil Aviation of Cuba, dinners and shows, and visits to the city's aviation museum and cigar factory. Visit *www.airjourney.com* or call (561) 841-1551 in Florida.

In the 1940s and '50s, during Cuba's aviation heyday, travel posters urged U.S. lightplane pilots to come join the party.

LEFT: COLLECTION OF JORGE L. RODRIGUEZ; TOP: COURTESY RAY ARNOLD

"We got 22 places we go, and only three places are accessible by road, and they're not open in the winter."

Some of his patrons have pretty sweet airstrips: 1,000 feet long, grades around 20 percent, elevations up to 7,000 feet. "People who have private runways maintain them better than the forestry service," Arnold says. Still, the surfaces are rough to rocky, "some flood with water; in the winter, you got snow and have to operate with skis. You learn a lot." (Arnold has logged 29,000 hours of education.)

Twelve years ago, Ray and his wife, Carol, divorced, but they remain partners; she runs the office, he flies the mail. "Neither of us could afford to buy out one another," Ray says. Son Mike, 45, who has been with Arnold Aviation for 20 years, is director of maintenance.

"Ray's my ex-husband," says Carol, "but you got to hand it to him: For 72 years old, he made 17 landings and put five hours on the tachometer the other day. They're unimproved strips in the wilderness. And there are not too many airline pilots who have 17 landings in one day."

The Postal Service sent the Arnolds' customers cancellation-of-service notices as of June 30. The customers fussed to Idaho's senators and the Cascade district's Congressman; the legislators groused to the Postal Service, which followed up with a continuation-of-service notice. "They spent more money hassling over it than what the contract cost," Ray Arnold says.

PHIL SCOTT

Brigadier General Iftach Spector

UNTIL RECENTLY, SPECTOR, AN ISRAELI AIR FORCE ACE, STILL INSTRUCTED FLIGHT STUDENTS FOR THE IAF. HIS LATEST BOOK, LOUD AND CLEAR *(ZENITH, 2009), IS BOTH A MEMOIR AND A DISCUSSION OF HIS VIEWS OF HOW THE ISRAEL DEFENSE FORCE, ESPECIALLY THE AIR FORCE, FIGHTS WARS.*

You flew combat missions in three wars and in two distinctly different aircraft, the French Mirage III and the American F-4 Phantom.

The Mirage was a lightweight, agile fighter with performance almost identical to the MiG-21. The F-4 was a behemoth, fast and strong but not very maneuverable. We called it the Sledgehammer and the Mirage, Skyblazer. When the F-4 arrived in 1969, it was a very hot airplane, difficult to reach in our Mirages. The Phantom was a more sophisticated aircraft. Not easy to fly, but it gave you a special feeling when you succeeded. In comparison, the Mirage was a very easy aircraft, a real beauty.

COURTESY IFTACH SPECTOR

Spector dotes on his seven-year-old grandson, Lihu.

How did the MiG-21 stack up against the Mirage and F-4?

The MiG-21 was a good match for both in air-to-air combat. Our high rate of success came from our tactics and training at that time, and from the weapons that the MiGs didn't have, namely the Mirage's two 30-mm cannons that ensured destruction if they hit, and the Israeli Shafrir and American Sidewinder infrared-seeking missiles.

IAF flight training is generally acknowledged to be among the best in the world. Attrition is very high, with barely 10 percent of the original class earning wings.

The training changed the basic approach from discipline and incessant testing to the instructor giving the student a helping hand. We were on a higher level than our adversaries because of much better training. But they flew their planes well. They had superior numbers and we were always short of fuel, while they were always close to their bases. We had a saying: In every fight, believe that your adversary is the best pilot in the world; prove that he is not!

How are successful fighter pilots different today physically and mentally from the time of the Mirage III and the Phantom?

The importance of sharp eyesight and manual flight skills is reduced by the introduction of radars and computerized flight systems. The human capacity to manipulate information became crucial. The taking in and manipulation of information can now be done better and cheaper out of the cockpit. In my view, besides the changes in the meaning of the term "fighter pilot," the time of this profession is nearing its end.

In your new book, you express a lot of your military and political views, some of which are not always in tune with official viewpoints.

My opinions, like everybody else's, developed and changed throughout my life. One thing I am proud of is that I never hesitated to speak out. I think this helped the IAF more than any puppet could.

INTERVIEWED BY PETER MERSKY

Read the entire interview at www.airspacemag.com.

Flight at the Museum

KARA FAHY STANDS IN FRONT of the classroom gazing at the seventh grade boys visiting from St. John Regional Catholic School in Frederick, Maryland. "Who knows the myth of Icarus?" she asks. "How does it go?"

A student raises his hand and recounts how young Icarus, disregarding his father's warning about flying too near the sun, took off on wax-and-feather wings and plunged into the sea.

"So what's the moral of the story?" asks Fahy.

The student thinks for a moment. "Don't fly?"

It's a typical day in the Learning Lab for Fahy and her colleague, Deborah Jackson, both aerospace educators at the National Air and Space Museum's Steven F. Udvar-Hazy Center in Virginia.

Jackson and Fahy have 11 labs for visiting schoolchildren; this one, Forces of Flight, outlines flight's four basic principles: weight, lift, thrust, and drag. After quickly covering the Montgolfier brothers' 18th century experiments with hot-air balloons and the 19th century gliders of Otto Lilienthal, Fahy takes the students onto the Museum floor, where they'll examine the Wright Model B. Because the aircraft is a reproduction, built and donated by Ken Hyde and the Wright Experience, the students are able to touch some of its parts, including its wooden propeller.

The St. John students are interested in space travel, so after returning to the lab, Fahy talks about NASA's Constellation program, which calls for colonizing the moon and traveling to Mars.

"Let's talk about force," says Fahy. "How does gravity work on you? What would it be like to move around, if Earth's gravity was twice as strong?"

"It would be like Krypton," offers a student. "You know, the planet where Superman's from?"

Despite their joking, the students are eager to learn. "Why does the moon have enough gravity to affect the tides of the Earth, but it can't hold you down on the surface?" asks another student, giving Fahy the opportunity to explain how mass affects gravity in space.

Jackson and Fahy generally teach four sessions a day, with 30 students in each class; they can accommodate students ranging from kindergarten (youngsters get a 60-minute session)

"What would it be like to move around, if Earth's gravity was twice as strong?" asks Fahy. "It would be like Krypton," offers a student. "You know, the planet where Superman's from?"

– KARA FAHY'S CLASSROOM DISCUSSION

The Wright Model B (above and right) is just one tool aerospace educators Kara Fahy and Deborah Jackson (at right) use to explain the principles of flight.

DANE PENLAND (3)

through 12th grade (older students are offered a 90-minute lab).

The position of aerospace educator lasts for two years; Jackson is finishing her second year and will return to Loudoun County, Virginia public schools, where she teaches special education classes. Fahy, who teaches elementary school in Fairfax County, is just beginning her second year.

In the lab, Fahy asks the students to speculate about what a change in air pressure would do to a pilot's lungs. To demonstrate such a change, she puts a Marshmallow Peep inside a vacuum chamber. As she pumps the air out of the chamber, the Peep expands dramatically.

"It's going to explode!" yell the students. "Can we eat it?"

"No, these are Peeps in the name of science," says Fahy. "We can't eat these." As she releases air back into the chamber, the Peep shrivels, then does a wild somersault.

"OK, how's it look?"

"Deflated," comes the response. "Like an old person," a student adds helpfully.

The experiment allows Fahy to talk about flightsuits and spacesuits, pressurized airplane cabins, even "the bends," the decompression sickness divers experience.

After discussing thrust and drag, Fahy has the students select items for a survival kit, part of a test created by NASA.

"Imagine you've crash-landed on the moon," says Fahy. "It's going to take three to five days for a rescue mission to get to you. What do you need to survive in space?"

The students work in teams, quickly discarding the compass, parachute, and matches in favor of oxygen, water, and food.

As the lab winds to a close, the boys head out for a docent-led tour of the Udvar-Hazy Center. Who knows what their future holds? It's possible that one or more of these students will become the very scientists who take us to Mars and beyond.

REBECCA MAKSEL

To learn more about the education programs offered at the Steven F. Udvar-Hazy Center, and to make reservations for a class visit, go to *www.nasm.si.edu/education*.

Visitor Information

Star Party Join Museum staff astronomer Sean O'Brien on two Saturdays, July 25 (from 8:30 p.m. to 11 p.m.), and August 22 (from 8 p.m. to 11 p.m.), in observing celestial objects in skies unpolluted by city lights. Sky Meadows State Park, Virginia. Parking fee: $4 per car. Park phone: (540) 592-3556.

What's Up Receive regular updates on Museum events, read about artifacts, get detailed (and behind the scenes) exhibition information, and receive calendar listings, all by subscribing to the National Air and Space Museum's free monthly e-newsletter, *What's Up*. Sign up at *www.nasm.si.edu*.

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ARTIFACTS

Just the Right Key

A COMBINATION CALCULATOR-GRAMMAR CHECKER? No, it's the tool Apollo astronauts used to communicate with their guidance computers. Although computers were set up to control much of the mission automatically, this display keyboard, or DSKY (pronounced "dis-key"), allowed astronauts to key in data and instructions to the command and lunar modules. (The command module had two DSKYs; the lunar module, one.) Astronauts entered numerical codes in "verb-noun" combinations, using the number pad and the sign and instruction keys. Verb codes indicated the desired action ("display"), while noun codes specified where the action was to be applied ("velocity"). An early version of an Apollo design, this DSKY was given to the National Air and Space Museum by NASA in 1972, and is on display at the Museum's Steven F. Udvar-Hazy Center.

This early display keyboard was later modified for manned lunar flights.

Recovery: Bataan

TWO FIGHTERS went after each other at midafternoon on February 9, 1942, with machine guns blazing. They were scant feet above the dense jungle enveloping the Mariveles volcano on the Philippines' Bataan peninsula. Sergeant Toshisada Kurosawa, Imperial Japanese Army, was flying a Nakajima Ki-27 "Nate"; U.S. Army Air Forces Lieutenant Earl R. Stone was in a Curtiss P-40 Warhawk.

The two airplanes circled, popping in and out of a cloud layer blanketing the peak. Finally the Ki-27, having emerged from the mist, slipped behind the P-40, trailing white smoke. As both aircraft approached Cogon Tarac, a spiny ridge that juts from the volcano, red tracers arced toward the P-40. The airplanes disappeared into the murk.

Reports suggested the two aircraft may have collided in the clouds. When the American pilot failed to return to his base, a search party was sent up Cogon Tarac. The searchers found the wreckage of the Ki-27 and thought they could see what remained of the P-40, but could not reach it.

Over the decades, attempts to locate the P-40 crash site failed, much to the disappointment of the Stone family. Stone's younger brother Westcott, himself a World War II combat veteran, had promised his late father that he would bring his brother home. In 2006, Wes Stone, having learned of my interest and experience in aircraft archaeology, enlisted my help.

After an airplane crashes, aircraft archeologists deal with the effects of compression, tension, shear, torque, and their combinations. Every piece of wreckage holds a clue to the airplane's last moments. Our role is to find the fragments and put the story together.

Spike Nasmyth, an American prisoner of war in North Vietnam, and Australian photographer Kevin Hamdorf organized a search team at Subic Bay. On February 6, 2008, I joined them and our guides. Our group of 18 headed south in convoy and ascended the volcano.

A deformed machine gun from the Nakajima Ki-27 spoke volumes to the author (center).

After five tough hours, two Philippine Aeta guides and I were the first to top the ridge. We offloaded our gear. I put on gloves and a hydration system and followed lead guide Eric Flores over the side.

Descending the 45- to 50-degree slope, we had to keep a tight grip on sawgrass or shrub. Eighty feet below, the ground leveled out onto a narrow ledge amid a thicket of saplings. There was a radial engine, single-bank, nine-cylinder, the type used by the Ki-27, lying on its back.

I could see no large pieces of fuselage or wings nearby, so the site had likely been disturbed. We climbed down and I eased along the escarpment in both directions, trying to define a debris pattern. No matter how well a site has been scavenged, pieces too small to profitably salvage usually remain. But I found not a shred of material in either direction.

By now the porters had cleared vegetation from the engine. Both propellers had separated from the housing along the rotation axis, indicating the engine was still providing power at impact. The structure below and aft of the hub had been shoved inward, causing the engine mounts to fail, and the powerplant had somersaulted to its final resting place. A .50-caliber armor-piercing bullet had penetrated the gear box in front of the engine and jammed, unexploded, between two metal plates—a 90-degree deflection. It had no doubt caused an oil leak, and the

spraying oil hitting the hot cylinders would have produced the white smoke that had been reported. Until the oil was depleted, engine power would have been unaffected.

My guide found one of the airplane's 7.7-mm machine guns: soon, the other

KEVIN HAMDORF

was recovered. A member of a later expedition found an expended 7.7-mm shell case under the engine.

The main debris field began 10 feet below the engine. Just under the peat-like surface, pocked with volcanic rock, lay metal fragments, wires, and bits of cable. A shredded fragment of a main gear tire turned up, showing evidence of fire and bearing a single clue—the Japanese symbols for "Bridgestone"—signifying the tire had been made by the Bridgestone Corporation in Japan. As I cleared away soil, a piece of curved canopy glass emerged on end, indicating it had penetrated the soil with high energy. This had to be the initial impact point.

Nine feet below the previous finds, the tail skid appeared, jammed into peat between two boulders. Using my compass, I figured that for the skid to make its way into the notch between the boulders, relatively undamaged, the aircraft heading must have been 080 degrees plus or minus five.

Using the tail skid, engine, guns, and cockpit fragments, aligned in an area 35 feet long, I determined the fuselage orientation, approximate aircraft heading, and initial impact point.

The next morning, along with Aeta guides Gary Montemayor and his son, Noel, I outlined the area where I thought we might find remains. We dug by hand to avoid starting an avalanche. I found a boot legging, then another. A boot heel turned up, then fragments of a skeleton.

Meanwhile, guide Jon Mar Benito led a second search party farther up the ridge looking for the P-40 site. Hours later they returned, dehydrated, exhausted, and empty-handed.

That night I slept fitfully in my tent with the bones of Sergeant Kurosawa wrapped beside me. Outside, the wind howled while the Aetas crouched behind a boulder, trying to keep candles lit to appease the gods for disturbing the dead.

By sunup, thoroughly chilled and short of water and food, we returned to civilization, bringing with us the sergeant's remains, to be turned over to Japanese authorities, plus numerous parts found at the Ki-27 site.

On Nasmyth's patio at Subic Bay that evening, I assembled the Nate remnants. The barrel of one machine gun was curled like a pig's tail. Its muzzle showed no abrasion, indicating that at impact, it had stuck firmly into the peat. The other gun had a smooth downward bend. Its muzzle showed abrasion, suggesting sliding contact with a boulder. The type of deformation indicated that at impact the barrels had been very hot. The weapon with the upward curl had been mounted on the right side of the engine cowl, the downward-bent weapon on the left. Reverse the positioning of the guns and you'd have to figure they had bent in the direction occupied by the engine block, likely an impossibility. For the guns to bend in opposite directions, the airplane probably was rolling right at impact. During his pull-up, the pilot was trying to align with the ridge. He nearly made it: 87 more feet and he would have cleared it. For the barrels to twist in the fashion they did, the pilot had to have been firing moments before impact. Kurosawa had likely been in a left turn while firing at something—the P-40? Since the machine guns' empty shells are ejected through a chute, the discovery of the expended 7.7-mm round confirmed firing just prior to impact. Kurosawa then saw either his opponent hit the ridge or the ridge itself. If at that point Kurosawa had completed his firing pass, his nose would have been to the right of Stone's aircraft when he saw the impact or ridge. In that case, the P-40 should be located slightly left of and lower than the Ki-27 crash site.

For decades, more than a dozen teams had looked for the P-40 in the wrong area. But before we could investigate, the rainy season set in.

After the ridge dried, I got an e-mail from Nasmyth dated Feb. 12, 2009:

Ralph, we sent Gary and 6 Aeta tribesmen up the mountain Monday the 9th of Feb, the 67th anniversary of the dogfight. They have found the plane.... I think this has to be Earl Stone's site, can't have been too many other planes out there within 400 yards of the confirmed Nate site.

After an aircraft crashes, every piece of wreckage holds a clue to the airplane's last moments. Our role is to find the fragments and put the story together.

On March 17, the search team and I began a two-day climb and descent on the Mariveles slopes. Some 350 yards beneath and to the left of the Nate wreckage lay the impact crater and debris of the P-40 flown by Earl Stone. We made some test digs, gathered parts to confirm the find, and notified the Joint POW/Missing-in-Action Accounting Command in Hawaii to begin the recovery of his remains.

RALPH WETTERHAHN

Brooders vs. Extroverts

The thing is, helicopters are different from airplanes. An airplane by its nature wants to fly and, if not interfered with too strongly by unusual events or by a deliberately incompetent pilot, it will fly. A helicopter does not want to fly. It is maintained in the air by a variety of forces and controls working in opposition to each other, and if there is any disturbance in the delicate balance, the helicopter stops flying, immediately and disastrously. There is no such thing as a gliding helicopter.

This is why a helicopter pilot is so different a being from an airplane pilot, and why in general, airplane pilots are open, clear-eyed, buoyant extroverts, and helicopter pilots are brooders, introspective anticipators of trouble. They know if anything bad has not happened, it is about to.

Harry Reasoner
Approach magazine, November 1973

I WAS A BRIGHT-EYED OPTIMIST until I flew a single-engine Army helicopter. I endured flight school when I was 22 years old, a new alumna from Davidson College, ready to show the United States Army what I was made of and single-handedly change the institution itself. I then met "Mr. Young," my primary instructor pilot. He was a wise, masterful, and ornery Vietnam War veteran who embodied the description of helicopter pilots as "introspective anticipators of trouble." I sat down across the table from Mr. Young. He said, "There is no cursing in my aircraft, no taking the Lord's name in vain, no back talking. My opinion is the only one that matters. You will be prepared every day or you will not fly."

I soon learned from Mr. Young and all of my other instructor pilots that every minute you spend in a helicopter is one more minute that you cheat death. You must know the procedure for every malfunction that could occur in that turbine engine or its outside components. If helicopters lose power, they plummet. Your job is to control that terrifying plunge so that the main rotor blades remain intact and stay out of your cockpit, or control the fall so the resulting crack in your spine leaves you perhaps crippled but not paralyzed.

My husband is the quintessential airplane pilot: idealistic, with an exuberant, dimpled, and broad smile. I am his polar opposite: After several hundred hours in Army helicopters, I have a well-developed sense of doom. He will find the cloud's silver lining. I will find its tumultuous center.

The difference in our perspectives was highlighted one May day when Jeff, who had just earned his private pilot's license, took me flying in a Cessna 152. The day could not have been prettier in Alabama—light winds and clear, cloudless skies. He made a couple of touch-and-gos into the Troy and Andalusia airports; I was impressed. We had just taken off from the Andalusia airport and were at about 1,500 feet when the soothing growl of the engine ceased.

I looked at Jeff. "Very funny trick."

"I'm not joking," he said. "We just lost the engine."

The helicopter pilot in me freaked out. *So this is how I am going to die: in a tiny aluminum capsule crash in a farmer's field where no one will find us for days.* Jeff looked miles ahead of us and said, "I'm going to shoot for that field." Being used to flying a giant lawn dart, I thought, *No way will we make it.*

But the little airplane glided in perfectly. It was the most beautiful landing of the day: no broken back, no propellers in the cockpit, not even a damaged landing gear.

The bright-eyed optimist might have won that day, but I still believe a moderate dose of brooding introspection is healthy. As soon as you bring a helicopter to a hover and see how it takes both of your hands and feet to keep it from slamming into the parking pad, you begin every flight preparing for the worst.

DARISSE SMITH

DAVID CLARK

How Do You Spell Pearl Necklace? F-R-E-E.

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You read that right. If you'd like the Stauer genuine 18" cultured pearl necklace absolutely **FREE**, all you need to do is call us today or log on to the website **www.stauer.com**. There is no catch. If you're wondering exactly how we can afford to do this... read on.

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Why would we do this? Our real goal is to build a long term client relationship with you. We are sure that most of you will become loyal Stauer clients in the years to come, but for now, in this lousy economy, we will give you these pearls to help with your future gift giving ideas.

We did find a magnificent cache of cultured pearls at the best price that I have ever seen. Our pearl dealer was stuck. A large luxury department store in financial trouble cancelled a large order at the last minute so we grabbed all of them. He sold us an enormous cache of his roundest, whitest, most iridescent cultured 5 ½–6mm pearls for only pennies on the dollar.

But let me get to the point: his loss is your gain. Many of you may be wondering about your next gift for someone special. In the past, Stauer has made gift giving easier with the absolute lowest prices on fine jewelry and luxury goods. This year, we've really come to the rescue.

For the next few days, I'm not offering this cultured pearl necklace at $1,200. I'm not selling it for $300. That's because I don't want to SELL you these pearls at all... I want to *GIVE* them to you. This cultured pearl necklace is yours **FREE**. You pay nothing except basic shipping and processing costs of $25.95, the normal shipping fee for a $200–$300 necklace.

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The ELECTRIC AIRPLANE

IT'S JUST 55 MILES from my home airport in Los Angeles to the Tehachapi gliderport where Pete Buck has his hangar, but it's usually a jarring flight through torrents of wind that tumble eastward off the mountains like whitewater. Not today. The air is perfectly still. The hundreds of huge windmills that dot the ridges are motionless, the sky is without clouds, the visibility without limit. I've pulled the rpm way back, so that the grumble of the engine, through earplugs and a headset, recedes into the distance. The airplane seems to slide along frictionlessly, like a skater coasting, hands in pockets, on a pond of infinite blue.

An engineer with a youthful manner and a day job at the Lockheed Martin Skunk Works, Buck, 51, is waiting on the ramp when I taxi in. As we walk to his hangar, only our voices, and the occasional chirp of a bird, disturb the universal calm.

BY PETER GARRISON

I've come to talk with Buck about a novel airplane he's developing. It's an electric airplane—common enough in RC modeling, but still an oddity in the passenger-carrying world. Electric flying is going to be something like my flight this morning: not trying to get somewhere far off in a hurry, but just the beautiful sensation of being suspended in the air, of flight for its own sake. It's often said that every great advance in aviation begins with a new kind of engine; I suppose that putting electric motors into airplanes is such an advance, but in a somewhat backward direction: toward lower power, slower airplanes, less noise and stress, and a return to those jolly early days when merely to rise up into the air made you feel like some sort of god.

Electric flight goes back surprisingly far. In the 1880s a couple of French army officers named Renard and Krebs gave a hydrogen-filled dirigible, *La France*, huge batteries and an

8-horsepower electric motor that enabled it to do what no balloon had done before: return to its launch site at the end of a flight.

After that early triumph, however, all went quiet on the man-carrying electric-aircraft front and remained so for about 90 years. The current renaissance began with Robert Boucher, who pioneered the use of electric motors for model airplanes and in the early 1970s built a couple of pilotless solar-powered aircraft under contracts with the Defense Advanced Research Projects Agency. In 1979, the late Paul MacCready, whose Gossamer series of human-powered airplanes had brought him international fame, began working with Boucher. MacCready's company, AeroVironment, first tested an electric version of the piloted *Gossamer Penguin*, then went on to build *Solar Challenger*, whose two tandem wings were covered with more than 16,000 solar cells. Boucher's company, AstroFlight, whose principal business today is miniature motors and related gear for RC modelers, supplied the five-horsepower motor. *Solar Challenger* had no batteries; it collected sufficient energy from sunlight—4,400 watts—to take off, climb to 14,000 feet, and cruise at 40 mph. In 1979 it made a five-hour, 170-mile flight across the English Channel, consuming no fuel whatever. Today it resides, deservedly, in the Smithsonian.

AEROVIRONMENT

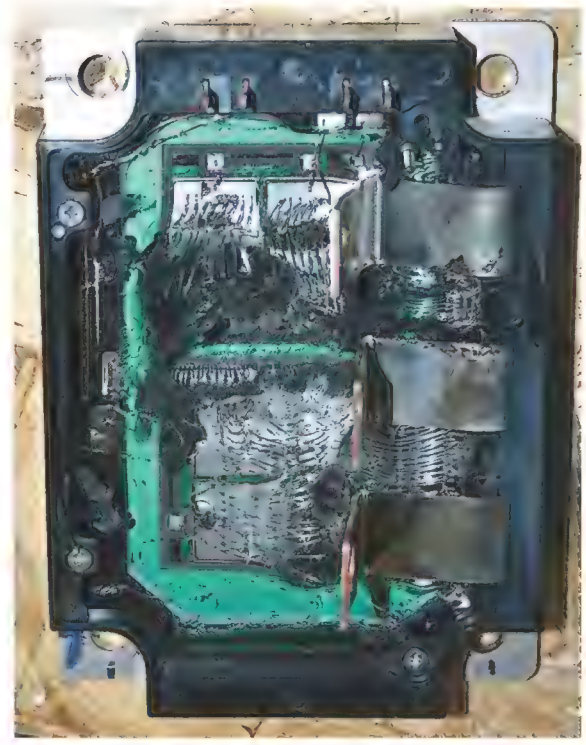
AeroVironment later built a series of ever-larger, unmanned solar-powered airplanes, culminating in the 247-foot, 14-motor flying-wing *Helios*, which, when it flew, resembled a phalanx of semi-inflated air mattresses bobbing on rough water. The eventual aim of the project was to circle for days as a sort of low-level observation or communications satellite, collecting and storing sufficient energy during daylight hours to sustain itself through the night. AeroVironment was never quite able to achieve that goal; the latest iteration in its long-running quest for "eternal flight," *Global Observer*, is powered by a hybrid system in which a highly efficient hydrogen-burning reciprocating engine drives a generator that in turn powers four electric motors. It is expected to be able to remain aloft for five days, in part because hydrogen has three times as much oomph, per pound, as gasoline. But the idea of an airplane that consumes no fuel continues to intrigue experimenters and adventurers; in Switzerland, one team has just crossed the Alps on solar power alone, and another has announced plans for an airplane, *Solar Impulse*, that is intended to circle the globe.

SONEX AIRCRAFT, LLC

HOWARD LEVY

Can Pete Buck (left) adapt technology from creatures like the 14-motor *Helios* (top) to convert a Sonex model into a practical electric airplane? Last year, Randall Fishman's ElectraFlyer-C prototype (above) beat other hopefuls into the air.

WHEN PETE BUCK "started poking at an electric airplane," as he puts it, he visited the same man Paul MacCready turned to: Robert Boucher at AstroFlight. "He mentored me in the design of the motor," says Buck, who, besides working at Lockheed Martin, is the chief engineer of Sonex, an Oshkosh, Wisconsin aircraft kit manufacturer. Buck and Sonex founder John Monnett are working on an electric conversion for one of the company's kits, an aluminum, V-tail two-seater called Waiex (pronounced



SONEX AIRCRAFT, LLC (3)

Sonex founder John Monnett (above) and Buck have found that scaled-up electric motors (like that in their Waiex modification, right) can suffer voltage spikes that fry the controller's electronics (above, right).

"Y-X"). Replacing a gasoline engine with an electric motor and some batteries sounds like a simple matter—those are familiar technologies, after all—but it turns out to be harder than it looks.

The project began a decade ago, when Buck and Monnett tossed around a whimsical idea for an electric airplane they called Flash Flight. It would have stayed aloft for 10 minutes on a bunch of D cells, and might have had potential for an ad campaign. Today, Buck dismisses it: "We finally decided it was silly, and it wouldn't work anyway." But he had caught the electric bug. He and Monnett outlined a more ambitious project: a genuine airplane, one that could stay aloft at least 20 minutes and, preferably, an hour and a half.

Their electric motor, a small cylinder bristling with cooling fins, is typical of the class of motor suitable for aviation: a 270-volt, 72-hp brushless DC unit with samarium-cobalt rare-earth magnets—the kind you would need a chisel to pry off your refrigerator door.

Magnetic forces—attraction and repulsion—cause the rotor (an electromagnet) of an electric motor to spin. Some types use two metal tabs, or brushes, with opposite charges; during each revolution, the rotor comes into contact with first one brush, then the other, each time switching its polarity. To perform the same function, a brushless electric motor relies on a solid-state switching device called a controller. Rapid switching of high-voltage currents, however, turns out to be difficult. The currents have momentum, just like moving water, and a random surge can quickly vaporize even quite massive transistors. Another problem is more mundane: The motors are hard to start.

"The controller is really where it's at," Buck says. "It should be cookbook, but it's not that easy. None of us recognized the complexity. There are only a few people who know how to do it, and they aren't talking."

The battery pack consists of a stack of thin lithium-polymer cells that resemble foil-wrapped legal pads. "We always thought the batteries would come to us," Buck says—meaning that they sized the airplane and motor for batteries that didn't yet exist. "There are batteries out there that have five times the energy density of those we can buy today, but they're only in the lab." And the Sonex team wanted the electric airplane to be comparable in price to the aircraft now being built from the Waiex kits. "We've always believed in an airplane that would be available at a price the average pilot could afford," says Buck, "so that the whole airplane, including the engine, would cost about the same as a new car, around $26,000."

Batteries are, in the final analysis, the key to the whole project. Controllers are tricky but feasible; motors are delicate and expensive, but technically straightforward. It's really on batteries—developing ones that are powerful, durable, and not prone to burst into flame if mistreated—that the future of electric airplanes hangs.

A gasoline powerplant, with its fuel, accounts for about a quarter of an airplane's takeoff weight. An electric powerplant is somewhat heavier to begin with; it adds 75 pounds to the weight of the Waiex because the batteries alone weigh 200

pounds. The big disadvantage is that the energy available from all those batteries is equivalent to only a couple of gallons of gasoline. Observes Buck: "We pilots would consider that 'unusable' "—the technical term for dregs in the bottom of the fuel tank that may not be available in all flight attitudes.

Buck aims at an airplane of conventional dimensions—with a little more wingspan than most, but able to be tucked comfortably into an ordinary hangar—and having climbing and cruising capability comparable to that of a gasoline-powered airplane in every respect except, perhaps, duration of flight. In other words, he and Monnett want to prove that an electric airplane can look and fly just like a gas-powered one.

Greg Cole sees things a little differently.

Cole, 46, is a freelance aeronautical engineer. His Oregon company, Windward Performance, produces a carbon-fiber sailplane called the SparrowHawk, which, at 155 pounds empty, weighs less than many of the pilots who fly it. Cole is a bit of a visionary. He is concerned not just about the price of gasoline, but also about aviation as a whole—the possibility that the cost and the complexity and stress of flying modern airplanes might drive people away from flying. He is not just an engineer; he is a reformer.

Cole, like Monnett, is preparing to manufacture an electric two-seater. The wingspan of his design is a glider-like 51 feet—a rather cumbersome size for taxiing, parking, and hangarage at many general-aviation airports. The longer an airplane's wingspan, though, the less power it needs to lift a given weight. Cole's motor, similar in design to Buck's but smaller, is rated at just 40 hp. If he can keep his airplane's empty weight below 500 pounds or so—the SparrowHawk demonstrates his ability to engineer very light, yet strong structures—he will be able to climb at 660 feet a minute and cruise at 70 mph on the electrical equivalent of one gallon of gas per hour. "We need to get into lower-power airplanes," he says. "We need to do smaller." He brushes aside objections that his design will not mesh easily with existing infrastructure. Electric—smooth, quiet, nonpolluting, and with motors that will never fail or wear out—is "a completely viable way to revolutionize aviation."

The aviation he is talking about is recreational: "I'm not looking beyond two seats." His airplane will cost $50 an hour to operate; $30 of that is a reserve for replacing the battery pack after 500 to 1,000 charging cycles. Because the airplane itself has very low drag and is highly efficient, the cost of the electric "fuel" is negligible. Cole's ultimate vision of sustainability is right out of the *Whole Earth Catalog*: A couple of small wind-powered generators on the roof of a hangar would, with sufficient wind, provide power for one or two flights a week. In a pinch, he concedes, "You could always top off from [an electric socket in] the wall."

Cole has made little effort to publicize his project; Monnett, on the other hand, announced his "E-Flight Initiative" in 2007 at the Experimental Aircraft Association's annual Oshkosh fly-in and displayed a mockup of the new powerplant. But a 59-year-old retired jeweler and self-taught engineer from New Jersey, Randall Fishman, stole a march on both Monnett and Cole. In 2008 Fishman, whom his friends used to call Doctor Gizmo, flew his single-seat electric airplane in front of cheering crowds at Oshkosh. The airframe is a discontinued Moni motor glider (built from a kit designed, coincidentally, by John Monnett before he started Sonex), modified and refitted with an 18-hp electric motor. It can cruise at 70 mph, using just 6 hp to stay aloft. A 90-minute flight consumes 5.6 kilowatt-hours of electricity—about 70 cents' worth, at present rates. It recharges from a wall outlet in six hours.

"I used to like to fly ultralights, but they

MORGAN SANDERCOCK (2)

Flying quiet in his SparrowHawk glider, Greg Cole is developing an electric motor to take the place of the tow plane. Below: Cole (center) prepares an engine test with his dad (right) and helper Jose Gomez.

SONEX AIRCRAFT, LLC

Sonex models (above) are just right for the team's electric propulsion kit, but Monnett and Buck hope to line up customers flying any 80-hp aircraft.

were powered by Rotax snowmobile engines," Fishman says. "They were so loud. And after you flew for a while and landed, your body would still be vibrating." In his pursuit of quiet, vibration-free flight, Fishman has been honored by the EAA, which recognized his contribution to light aircraft design with the 2008 August Raspet Award. (John Monnett is a previous winner, as is Pete Buck, though not for their work in electric power.) And this year the Lindbergh Foundation awarded him a $10,580 grant.

Like the Wright brothers, Fishman started with a bicycle. He used to have to pedal uphill to get to his jewelry store, and he didn't want to arrive sweaty. When he saw an ad for an electric bicycle motor, he thought: *That would be nice.* More than 20 years, hundreds of thousands of dollars, and several electric conveyances—a scooter, an ultralight Trike, and the ElectraFlyer-C—later, Fishman is working on a two-place electric airplane he says will be ready to fly this fall. With motor experts, he has developed an electric propulsion kit including 100-hp motor, battery pack and battery management system, and throttle to control the speed at which the batteries discharge.

"We're using a lot of very inefficient, crappy technologies to waste the gas that we can get so cheap," says Fishman. "Six-thousand-pound cars to move around people who weigh about 80 pounds. It seems normal to us. This is not the way we should be doing things."

The irony of electric airplanes is that their economies are tiny.

Miles per Kilowatt

WHEN YOU POWER airplanes with electric motors, you have to talk in watts rather than horsepower. They are measures of the same thing, like feet and meters, but the units are different sizes.

1 hp = 746 watts,
or 3/4 kilowatt
1 kilowatt = 1 1/3 hp

The power of the engines in existing one- and two-seat airplanes at the lower end of the performance spectrum is between 14 kilowatts (Rutan Quickie) and 60 (Waiex). Current airplane engines consume about a gallon of gasoline per hour for every 13 horsepower, or 10 kilowatts, they produce. The average cost of electricity, nationwide, is 12 cents a kilowatt-hour, and so the 10 kilowatt-hours' worth of power that you get out of a gallon of gasoline would cost $1.20 in the form of electricity. Some energy is lost on the way from the wall outlet to the propeller, however, so electricity is really equivalent to $1.50-a-gallon gasoline.

Airplanes have excess power to allow them to climb, and they usually use that power to cruise at a speed much higher than their most efficient, most fuel-conserving speed. A gasoline-powered airplane typically carries enough fuel to climb several thousand feet, cruise at a high speed for two or three hours, and land with some reserve left in the tank. Its fuel capacity in gallons is typically at least a fifth of its installed horsepower. An airplane with a 75-hp engine might carry 15 gallons of fuel — the equivalent of 150 kilowatt-hours of energy.

That's where the trouble begins. If we take the word "fuel" to include any medium for storing energy, including batteries, the problem for electric airplanes boils down to something called energy density: the amount of energy a pound of "fuel" can hold. In this sense, gasoline is wonderful stuff. A pound of it contains 5.75 kilowatt-hours' worth of pure energy. Batteries, in comparison, are pitiful. The best practical batteries today store, per pound, perhaps 1/80 of the energy of gasoline. It takes 15 pounds of batteries to store one kilowatt-hour of energy. Cow dung, a popular cooking fuel in many parts of the world, far outshines any battery.

Luckily, batteries, weak as they are, have some strengths, and gasoline has some weaknesses. One fundamental difference is the superior efficiency of electrical power systems. Gasoline releases energy by burning, and in the process much of its potential energy oozes through cylinder walls or pours out in the exhaust gas as waste heat.

COURTESY PIPISTREL

The Pipistrel Taurus sailplane uses its 53-hp motor only for taking off and climbing (at 9.5 feet a second).

Since electric powerplants are confined, at least for the foreseeable future, to small, light, and slow airplanes that don't require a lot of energy in the first place, the savings to be realized from using electricity—which is roughly equivalent to $1.50-a-gallon gasoline—is rather small (see "Miles per Kilowatt," below). Conventionally powered airplanes with the performance of electric ones use only one or two gallons of fuel an hour, so the difference in direct operating cost is negligible in comparison to the difference in initial outlay: for an airworthy gasoline engine, $100 per horsepower; for an electric powerplant, $400 or more per kilowatt. Greg Cole points out that in 10 years the price of gasoline will probably be "somewhere between bad and horrible." Besides, the price of fuel isn't everything; smoothness, quiet, reliability, and freedom from maintenance have value, as would the environmental benevolence of an airplane fueled entirely by locally harvested sunlight or wind.

COURTESY SOLAR IMPULSE

HOWARD LEVY

With electricity converted from solar cells, *Solar Impulse* (above, left, under construction) will take balloonist Bertrand Piccard on a days-long, round-the-world attempt in 2011. Last year, Randall Fishman (kneeling) and test pilot Joseph Bennis were happy with an hour-long flight a few times around the pattern.

OUTSIDE HIS HANGAR, Pete Buck and I survey the rows of tied-down airplanes, sailplanes, and sailplane trailers. Nobody is flying today, because there's not enough air movement to keep a glider aloft. I reflect upon the dubious economics and ask him point-blank why anybody would buy an electric airplane.

"Stupidity," he laughs. "It's just like a hybrid car. You can't justify a hybrid car economically. You never get the price differential back. Just pump gasoline—there's nothing better!"

Obviously, he's kidding. For Buck and Cole and Fishman and others like them, there's more to it than just a bad bargain. It's more like a love affair. And if they can fall in love with an idea like this, other people can too. There has to be a reason why, when I'm back in Los Angeles and driving home from the airport, it seems as if every other car I see is a Toyota Prius.

Miles per Kilowatt

Heat is the evil twin of useful work; energy spent heating up the surroundings cannot be recovered. Even modern, well-designed gasoline engines waste between two-thirds and three-quarters of the energy released by their fuel.

Electric motors, on the other hand, are highly efficient. Friction losses are very low, and the passage of electric current generates little heat. The best electric motors make useful work out of 90 to 95 percent of the energy put into them, so the gap in energy density between gasoline and present-day batteries falls from 80-to-1 to, say, 30-to-1. If you look at the total weight of the powerplant – engine plus fuel – electricity gets another slight boost because electric motors are lighter than reciprocating engines, and so more of the total powerplant weight can be used for energy storage.

Experts say that in the next few years, batteries may be able to store two or three, maybe even five times more energy. So optimists expect that for airplanes currently under construction or on the drawing board, available battery-motor combinations will soon achieve an energy density of 1/10 that of gasoline.

One class of electric airplane is already in production: self-launching sailplanes. Since they require only enough power for an initial climb of a few thousand feet, current batteries are fine for them. There's also the possibility that fuel cells – which are like batteries that turn some sort of fuel, like hydrogen, into electricity – will become practical and affordable. But, despite a lot of research, tests, and hype, fuel cells remain firmly planted in the indefinite future.

The Art of a Moonwalker

For 28 years, Apollo astronaut Alan Bean has painted what he knows.

In Flight, 1990. While on the moon, Apollo 14 commander Alan Shepard used a makeshift six-iron to take golf to new heights.

From the day he entered flight training, Alan Bean thought he had the best job in the world – "until I looked on the TV one day and Al Shepard goes up in a rocket," he recalled in the 2007 documentary *In the Shadow of the Moon*. "He's gone higher than I've ever gone, and faster than I've ever gone, and most important, he's made more noise doing it. How do I get that job?" Bean *did* get the job, and on November 19, 1969, he became the fourth man to walk on the moon. He and Apollo 12 commander Pete Conrad stayed on the lunar surface for more than a day, 10 hours more than Neil Armstrong and Buzz Aldrin. Bean would go on to command the second mission of the space station Skylab, eventually logging more than 1,670 hours in space.

In 1981, after 18 years as an astronaut, Bean retired to paint full-time. His subject of choice has been the Apollo program, and in honor of the 40th anniversary of the moon landing, Smithsonian Books and the National Air and Space Museum present a new book and exhibition of his work: *Alan Bean: Painting Apollo, First Artist on Another World*. The exhibition will run through January 13, 2010.

– The editors

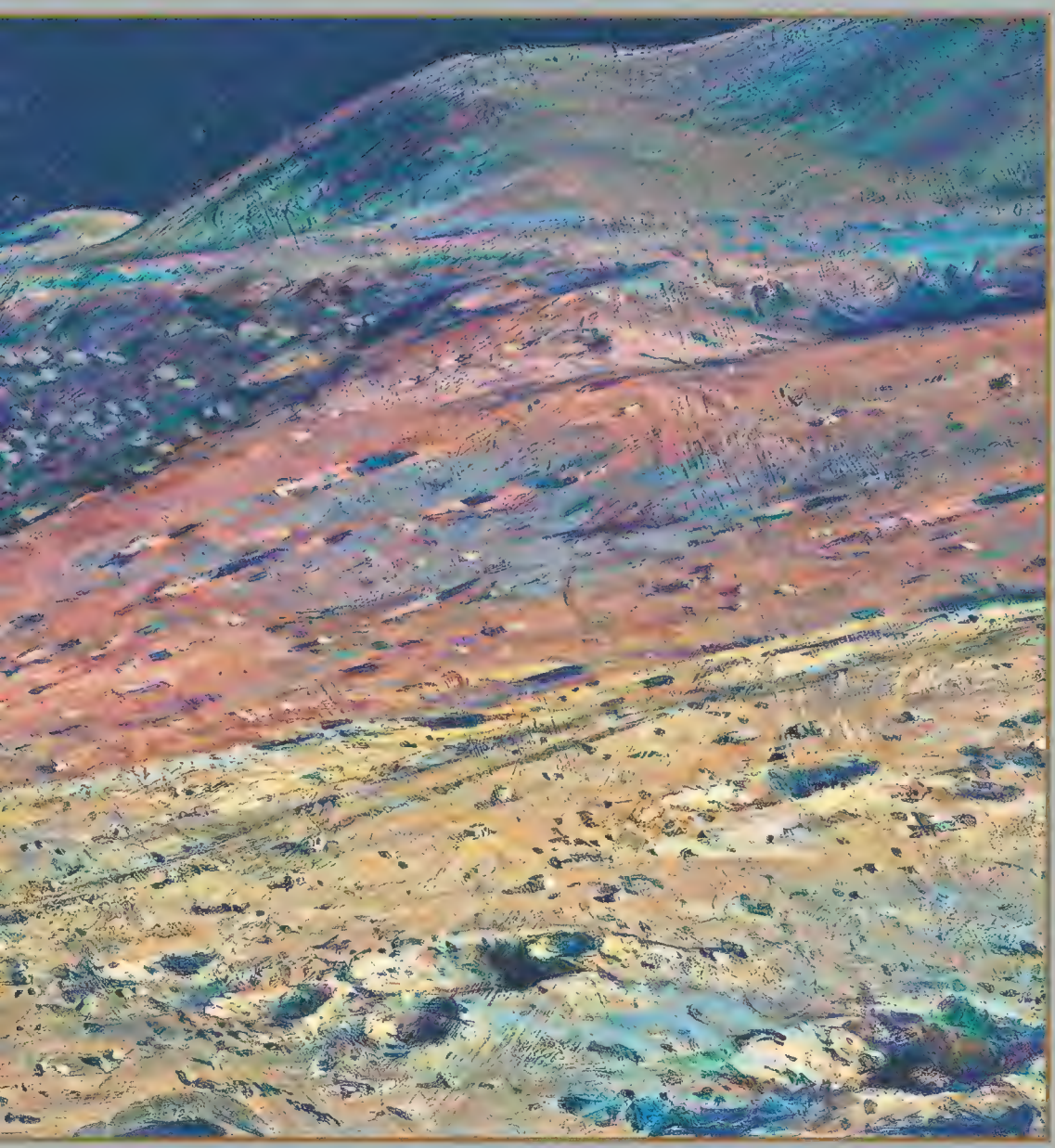
CAROLYN RUSSO

Alan Bean, former lunar module pilot of Apollo 12 and commander of a 59-day Skylab mission, at home in Houston, Texas, in his light-filled studio.

The landing site of Apollo 15, the Hadley Rille gorge stretches for some 70 miles. In Bean's 1996 painting *Hadley Rille*, Dave Scott (left) and Jim Irwin collect rocks for geologists interested in the rille's possibly volcanic origins.

Above: *Beyond a Young Boy's Dream*, 1989. As a child, Bean blanketed the ceiling of his bedroom with balsawood models. "Airplanes were the last things I would see before falling asleep at night," he recalls.

See more paintings from the book and exhibition.



Using the rock hammer he took to the moon, Bean scrapes textured surfaces into his paintings, below, a technique he began using in 1999. Bottom: Bean hopes to complete 200 to 250 paintings of Apollo during his lifetime.

ERIC LONG

ERIC LONG

HE WASN'T SUPPOSED TO DO IT, but on May 15, 1948, Lieutenant Colonel Paul H. Fackler, commanding officer of the U.S. Air Force 514th Reconnaissance Squadron Weather, flew his airplane into the seething mushroom cloud of an atomic bomb detonation.

As part of Zebra, the final shot of America's second series of atomic tests at Eniwetak atoll in the Pacific, Fackler had the job of tracking the atomic cloud from at least 10 miles away, hoping that special filters attached to the airplane would catch samples of the radioactive debris. But as he pulled away from the enormous roiling cloud in a climbing turn to the left, Fackler suddenly found his weather reconnaissance Boeing WB-29 inside a small finger-like projection of the main cloud.

"No one keeled over dead, and no one got sick," Fackler reported later, according to *History of Air Force Atomic Cloud Sampling*, a government document published in January 1963. He promptly left the cloud and continued his normal flight profile until his radiation safety officer, sitting in the B-29's nose monitoring radiation levels, announced the crew had reached their exposure limit: 100 milliroentgens, the amount a person receives annually from naturally occurring radiation from the sun and the soil. It was time to break off and head home to the air base on Kwajalein, in the Marshall Islands. Fackler flew through a few rainshowers to wash off radioactive particles.

Aside from the unstated objective of geopolitical saber-rattling, the main purpose of atomic bomb tests was to try out new weapon designs and improve existing bombs. Analyzing the tiny particles of fallout, trace elements, and short-lived radioisotopes unleashed by the nuclear reactions was the only way to get definitive data on just what had happened inside the multi-million-degree heart of an atomic explosion. But collecting that debris in the aftermath of the explosion was a challenge.

To weather reconnaissance pilot Paul Fackler (bottom), a cloud was a cloud, be it cumulonimbus or radioactive. One 1952 blast sent its cloud to 60,000 feet in 90 seconds (opposite). Below: Air Force personnel decontaminate a B-29 sampler aircraft with Gunk degreaser.

During the first postwar test series, Operation Crossroads in 1946, specially trained pilots in mothership aircraft guided unmanned drones through clouds of two consecutive explosions from a safe distance. The drones, retired Boeing B-17 bombers and Grumman F6F fighters, had boxes mounted on the fuselage or wings, lined with filter paper designed to catch radioactive particles.

Controlling the drones was tricky even under the best conditions, much less in the turbulence following a nuclear blast. Drones often crashed or went astray, and even when everything worked properly, they couldn't always collect the high-

TOP & OPPOSITE: COURTESY OF NATIONAL NUCLEAR SECURITY ADMINISTRATION / NEVADA SITE OFFICE; BOTTOM: AIR FORCE WEATHER AGENCY

INTO THE MUSHROOM CLOUD

AT THE DAWN OF THE NUCLEAR AGE, THE CREWS OF THE 4926TH TEST SQUADRON WERE ON RADIOACTIVE DUTY. BY MARK WOLVERTON

A technician employs the proverbial 10-foot pole to extract a contaminated filter from a Republic F-84. With samplers mounted, there was no room for wingtip fuel tanks.

quality samples craved by the physicists and radio-chemists at Los Alamos labs in New Mexico and Lawrence Livermore laboratory in California. All a controller could do was point his drone at the cloud and send it through blindly, hoping that by sheer luck the drone would catch a good sample and survive the landing.

But Fackler's stunt—whether purposeful or accidental, no one ever knew for sure—had raised an intriguing prospect. By the time the United States began the Ranger series of atomic tests at the new Nevada test site in 1951, Fackler and some supportive colleagues had convinced the military and the Atomic Energy Commission to try manned sampling flights. Monitoring aircraft could vector manned aircraft into the parts of a cloud most likely to yield good samples, and manned craft could respond to rapidly changing conditions much faster than a remote-controlled craft.

The second atomic bomb to detonate in the United States was triggered at 5:45 a.m. on January 27, 1951 (Trinity, the first, exploded near Alamogordo, New Mexico, on July 16, 1945), and at the time, Fackler was piloting a WB-29 toward the mushroom cloud. He depressurized the aircraft cabin and the crew went on 100 percent oxygen to avoid inhaling radioactive dust. Then Fackler took the aircraft through the cloud. He made a second pass, and then the radiation safety officer told him they were nearing their milliroentgen limit—the mission was over. Another sampling aircraft followed Fackler's through each of Operation Ranger's four remaining atomic blasts.

The flights were pronounced a success, and what had begun as a simple pilot error, then explored as a cautious experiment, became a vital element of America's nuclear weapons program. The sampling flights continued through further tests in Nevada, with the teams perfecting techniques and equipment, while Fackler pushed to establish a dedicated cloud sampling unit.

Meanwhile, the hydrogen age was about to dawn.

As Operation Ivy started in late 1952, the sampling flights had largely transitioned from relatively slow prop-driven aircraft to jets, whose greater speed gave crews less time to hang around in the cloud. They could also quickly reach higher altitudes, an important consideration for testing H-bomb detonations, which produce much wider and taller clouds.

When the world's first hydrogen weapon, in a test designated "Mike," wiped out the Marshallese island of Elugelab on November 1, 1952, four F-84G fighters carrying sample collection equipment on their wingtips were already in the air. Designated Red Flight and led by Lieutenant Colonel Virgil Meroney, the jets arrived in the area of the bomb cloud about an hour and a half after detonation.

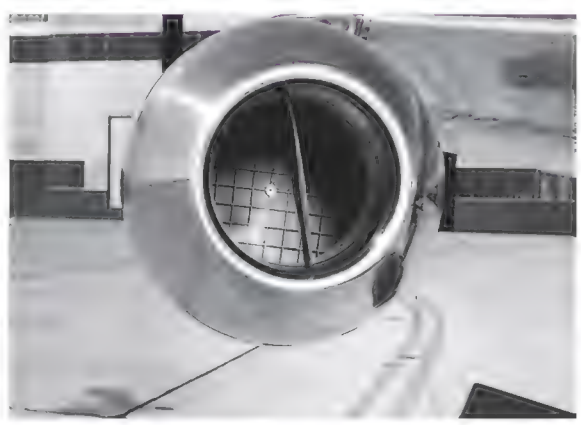
Under instructions from the Convair B-36 sampler control aircraft circling some distance away, Meroney and his wingman penetrated the mushroom cloud's stem at about 40,000 feet. (As predicted, the main cloud, which began forming at about 55,000 feet, was too high for an aircraft to reach. Samples from the stem would have to do.) Immersed in the dull red glow of the cloud interior, Meroney watched all his radiation instruments peg to their maximum readings. After about five minutes inside, he and his wingman executed a 90-degree turn and escaped.

Then came the rest of Red Flight: Red 3 with Captain Bob Hagan, and his wingman, Red 4, Captain Jimmy Robinson. Hagan calls the cloud "dark and boiling."

"While we were going through the cloud, Robinson became disoriented and spun out," Hagan recalls. Apparently, as Robinson pulled his airplane into a tight turn to escape what his instruments told him was a particularly hot part of the cloud, his autopilot disengaged, and as the jet stalled and lost altitude, he briefly lost control. Flight leader Meroney later reported hearing heavy breathing over the radio, as if Robinson had been holding down his mike button while fighting to control the aircraft. After Robinson reported that he had recovered at 20,000 feet, Meroney ordered him and Hagan to leave the cloud and rendezvous.

"I continued on out of the cloud and

Using a toggle switch in the cockpit, the aircraft crew could open and close the Los Alamos lab tank-mounted samplers.



LEFT: AIR FORCE WEATHER AGENCY (2); TOP: COURTESY NATIONAL NUCLEAR SECURITY ADMINISTRATION / NEVADA SITE OFFICE

then went down to 20,000 feet to try to find him, but that didn't work," Hagan remembers. "There was a refueling tanker there but they couldn't find us." Electromagnetic aftereffects from the H-bomb explosion were also wreaking havoc with their navigational and radio equipment, while their fuel supply dissipated. After being forced to spend almost an hour at lower altitude, where fuel efficiency decreases, Hagan and Robinson had eaten into their scarce reserves. "I decided we better head for a runway somewhere, and Enewetak was the only one that was around," Hagan says. He managed to pick up a radio beacon from the island and started off. Soon after, Robinson caught the beacon and followed Hagan.

Pacific cloud sampling missions had greater flying distances, so fuel was tight, and with F-84s unable to carry wingtip fuel tanks—that was where the cloud sampling filters were mounted—fuel capacity was even more limited. "When we got to Enewetak, my gas gauge was on empty," Hagan says. "Luckily on final [approach], I was able to set up a pattern and land without fuel, deadstick." On the hard landing, the right tire blew out.

Robinson wasn't as lucky. He reported to Enewetak tower that at 13,000 feet his engine had flamed out, but he thought he could make the runway. By the time he'd dropped to 5,000 feet, with the island and runway in sight, Robinson radioed that he was bailing out over the water.

A rescue helicopter spotted Robinson's F-84, wings level and gliding in, at about 500 feet, north of the atoll. To the rescue pilot, it looked as though Robinson had jettisoned his canopy but had decided to stay in the cockpit and try for a water landing. The craft hit the water, skipped smoothly over the surface, then hit a wave and flipped over. The rescue helicopter hovered over the jet as it sank rapidly. Robinson was nowhere to be seen.

"As I got out of my airplane," recalls Hagan, "the people in the tower told me that an airplane had just gone into the ocean behind me. They didn't see any signs of a parachute or anything." The sampling pilots wore lead-lined vests, which, along with the rest of their gear, would have made even bailing out problematic, let alone staying afloat.

According to official reports, Robinson's body was never recovered. "They searched but they couldn't find anything," says Hagan. "It's pretty deep right there. I wasn't around when they did it, but I heard later that they had tried and couldn't find the airplane or Jimmy at all. There must have been currents in there that took the airplane away." Captain Jimmy Priestly Robinson, age 28, would be awarded a posthumous Distinguished Flying Cross about a year later.

COURTESY NATIONAL NUCLEAR SECURITY ADMINISTRATION / NEVADA SITE OFFICE

An Air Force Special Weapons Center team uses an ion chamber to measure radiation on a B-29's engine cowling intake.

On April 1, 1953, Fackler's Pentagon campaigning paid off, and the 4926th Test Squadron (Sampling) officially opened for business. Until atmospheric nuclear testing finally ended, men would continue piloting specially equipped aircraft into radioactive clouds. In her 1999 study of cold war radiation experimentation, *The Plutonium Files*, journalist Eileen Welsome wrote: "Perhaps no humans got closer to the exploding heart of a nuclear weapon than the sampler pilots."

The men chosen for the missions had a lot of flying hours, usually including combat experience. Both Jimmy Robinson and Bob Hagan were World War II veterans; Robinson had been a B-24 pilot who had been shot down over Romania and done time as a prisoner of war, while Hagan had flown almost 100 ground support missions in a P-47 with the Ninth Air Force. Pleased to be picked for such an important job, the pilots shrugged off the possible dangers: "You know, young and dumb," Hagan laughs. But aside from great stick-and-rudder skills and exceptional instrument flying ability, a sampling pilot needed a knack for what's now called multi-tasking.

Paul Guthals, one of the cloud sampling project leaders at Los Alamos, explained in the Air Force history publication: "Pilots with the ability to succeed in sampling missions were difficult to find. They had to possess the ability to receive radioed instructions, make taped recordings of instrument readings, be alert for excessive radiation and myriad other details simultaneously.... Most pilots with less experience and proven ability were simply overwhelmed—so badly that they could not function satisfactorily—by the

awesomeness of the cloud interior."

By most reports, the world inside an atomic cloud was a turbulent, glowing, brick red. On his mission, Hagan didn't notice much color, but admits, "I didn't pay much attention because I was flying instruments." The reddish tint, from explosion byproducts such as nitrogen dioxide and iron oxides, provided pilots with a handy way to visually distinguish atomic clouds from cumulonimbus clouds.

Though they wore lead vests and their cockpits were usually lined in lead, the sampling crews soaked up more than their fair share of radiation—routinely far more than anyone else in the testing program. Besides the dose they received during the jaunts in the radioactive cloud, they continued to be bathed in radiation all the way home to base, sitting in an airplane coated with highly radioactive debris.

The choice of aircraft for the sampling missions was critical. The aircraft had to be fast, maneuverable, and easily modified to carry the sampling equipment. Particularly with the advent of the hydrogen bomb, it was also important that the aircraft be able to operate at high altitudes. Eventually, project leaders settled on two mainstays: the Republic F-84G fighter and the English Electric B-57 Canberra, built under license by Martin. Each met all the basic mission criteria and needed only a pilot and radiation officer, so fewer personnel were exposed to radiation. Later models of the B-57 had ceilings up to 60,000 feet, so the twin-engine jet bomber became the cloud sampling workhorse.

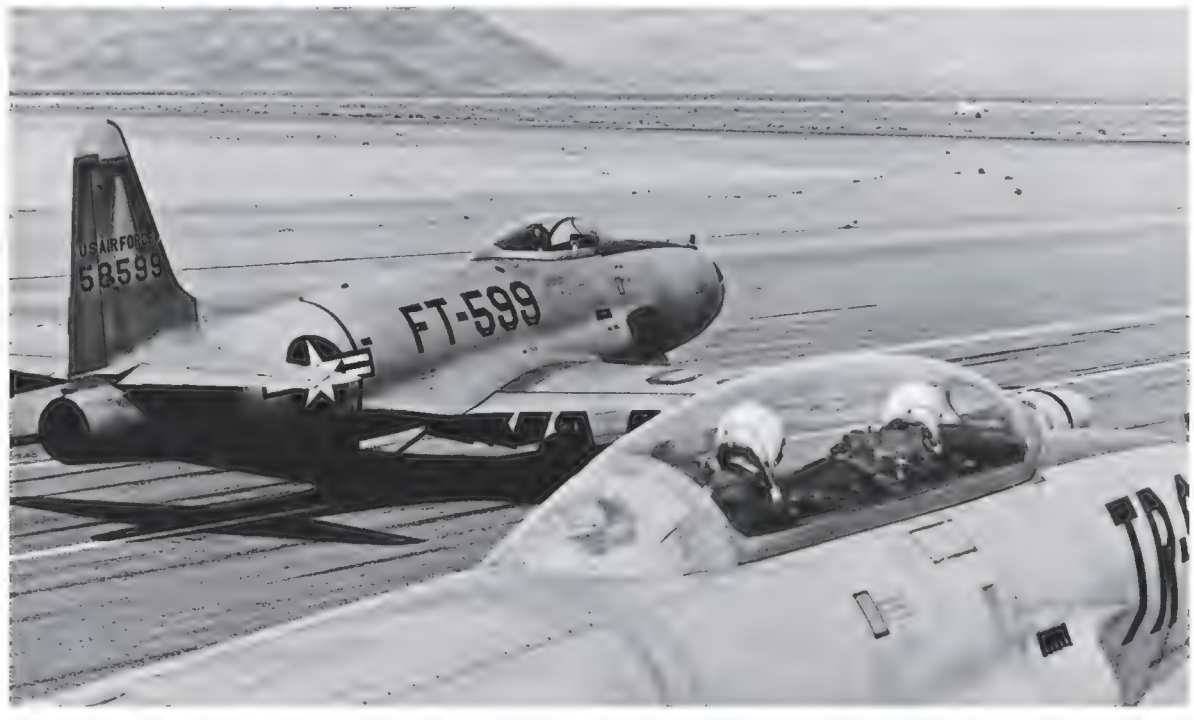
After a mission, the pilots parked in an area removed from the normal flightline of the Nevada or Pacific testing site airstrip.

A forklift enabled a pilot to exit a hot aircraft (top) without touching its skin. Paul Fackler (above, at left) oversees the plotting of a sampling mission.

But the crewmen couldn't just pop the canopy and hop out. Any direct contact with the airplane's exterior was hazardous. They had to shut down their engines and wait until a ground crew, in decontamination suits, approached with a forklift that would raise a platform to cockpit level. The pilot and radiation safety officer would step carefully out of the cockpit and onto the platform, taking care not to touch the aircraft's skin. After being returned to the ground some distance away, the crews were checked for contamination and directed to strip and shower immediately, repeating the procedure until Geiger counters stopped their furious clicking. The crewmen were given fresh clothing, while their contaminated gear, along with the radiation dosimeters they'd worn during the mission, were carefully packed up and sent away for analysis.

Meanwhile, five-man filter recovery crews used 10-foot poles to unlatch the sample boxes, remove the filters, and place them in lead-lined containers for shipment back to the labs. It took a certain amount of finesse and manual dexterity. "You wore lead-lined gloves and a vest, which probably did no good," recalls ground crew vet Lou Watts, who thinks many of his cohorts died early of cancer and sees some correlation. "All the ones that went to the '56 tests in the Pacific that I kept track of are gone."

Maintenance crews then thoroughly washed down the aircraft and scrubbed it clean of radioactive debris, using both soap and water and a cleaning compound called Gunk—although not even Gunk could render a contaminated airplane pris-



TOP, BOTTOM, AND OPPOSITE: COURTESY NATIONAL NUCLEAR SECURITY ADMINISTRATION / NEVADA SITE OFFICE; MIDDLE: AIR FORCE WEATHER AGENCY

tine. The best that could be done was to cleanse it to a reasonably low level of radioactivity, then let the remaining particles naturally decay. But because of the frantic pace of the testing program, most aircraft never sat idle long enough to completely cool off.

And some parts of an aircraft simply couldn't be reached. "You couldn't wash the inside of the engines," notes aircraft mechanic David Ellis. Pilot Langford Harrison told Carole Gallagher, author of *American Ground Zero*, that "since engines are oily by nature, they never did get the radiation out. They'd leave them out there for two or three days and then bring them back into service, emitting radiation like there was no tomorrow. We'd crawl into those things and fly through the cloud again...the same aircraft over and over. They should have been burned along with our clothes."

As the nukes kept detonating over Nevada and Enewetak and the cold war intensified, Atomic Energy Commission scientists argued with the Air Force over just how much radiation was too much. In 1951, when manned testing began, the AEC had specified that personnel participating in test operations could safely receive up to 3.9 roentgens of gamma radiation over three months. Once an individual had reached that level, he would be banned from further exposure until the remainder of the three months had passed.

That was the theory. In practice, the policy proved troublesome, particularly for the Air Force, which admitted as much in its official history of the sampling program: "The enforcement of radiological safety measures...was a continuing problem, with outright rebellion by Air Force operational leaders threatened on at least one occasion. They argued that no serious mishaps had occurred and that application of accepted radiological safety measures unnecessarily upped the requirements for manpower, lessened the readiness of crews and aircraft for tests, and that all decontamination program protection measures in use were more than actually required to insure safety."

By 1957, the controversy had escalated from mild grumbling into open administrative warfare, with Air Force Colonel William Kieffer pushing to seriously downgrade, if not entirely eliminate, most of the routine decontamination procedures. The scientific director of the sampling effort, Harold Plank of Los Alamos, argued that Kieffer "simply could not understand the philosophy which regards every radiation exposure as injurious but accepts minimum exposures for critical jobs." The safety and decontamination procedures continued—more or less—and the controversy was never resolved. Throughout the program, however, the officially permitted radiation dosage limits for Air Force personnel tended to drift upward to as high as the brass thought they could get away with.

In the early 1960s, spurred by increasing scientific awareness and public outcry over the dangers of fallout, nuclear testing began moving underground. The Limited Test Ban Treaty of 1963 made it final. The 4926th Test Squadron (Sampling) was absorbed into the Air Force Military Air Transport Service.

Jimmy Robinson's daughter, Rebecca Miller, a baby when her father died, spent years petitioning the government for more information about his last mission, with only limited success. "I guess [his body] is there, unless the plane and his body were recovered and it's still classified," she says. "I've had other atomic veterans tell me they thought he was sent back to Los Alamos to do a full body count of the radiation." It wasn't until 2002—50 years later—that Robinson would finally be given his due, with a full military ceremony and memorial stone at Virginia's Arlington National Cemetery.

Opposite, bottom: On April 6, 1953, at Indian Springs Air Force Base, Nevada, a QF-80 (at left) and a two-seat DT-33 mothership head for the test site of Operation Upshot-Knothole (right) on the first sampling flight by a jet drone.

APACHE

THE TALIBAN VS. THE WORLD'S DEADLIEST HELICOPTER.

BY ED MACY

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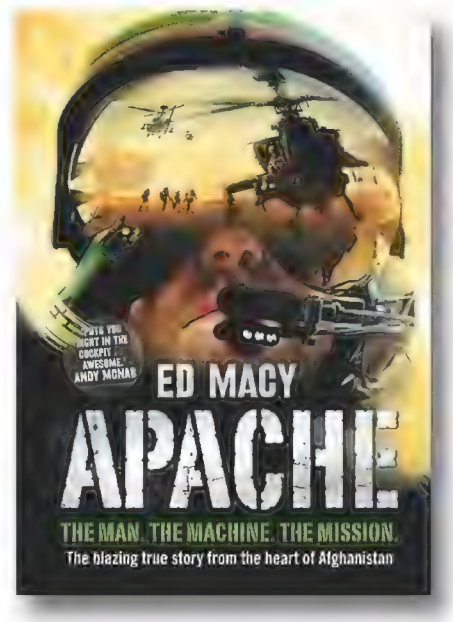
After 22 years in the British army, which included a tour in Afghanistan, Ed Macy was eager to begin civilian life, but because of a shortage of experienced weapons officers on the Apache AH Mk.1, he was recalled. In 2007, as part of an effort to contain a resurgent Taliban, Macy was sent on a raid on Taliban headquarters in the Helmand province, farther south than any British troops had ever been.

Lieutenant Colonel Rob Magowan's battle group mapped the Taliban main supply route from Pakistan, locating five staging areas where fighters and supplies were concentrated. These became the primary targets for the Army Air Corps' Operation Glacier. Macy's company, the 656 Squadron, Apache helicopter company—call sign "Ugly"—was tasked with destroying the route, beginning with a site near the village of Koshtay and moving steadily north. The success of the first raid paved the way for the second part of Operation Glacier.

The following excerpt is from Apache, *by Ed Macy (Atlantic Monthly Press, 2009). In a few instances, names of individuals have been changed to protect their safety.*

FOR THE FIRST TIME THE TALIBAN WERE ON THE DEFENSIVE. The brigadier wanted to keep it that way. The Royal Marines had taken a pasting from the Taliban in the three months since they'd arrived in September 2006. Now we'd given a bit of the pasting back. The order came down to launch Operation Glacier 2 as soon as possible.

The mission was to destroy the Taliban's main forward operating base in southern Helmand. It was a giant, high-walled rectangular compound, 200 meters long by 100 wide [220 by 110 yards], on the banks of the Helmand River where the Green Zone borders the Desert of Death in the west. It was extremely well fortified, with stone and adobe walls 10 feet high and three feet thick, and guard towers at each of its four corners. It was known locally as the Jugroom Fort.



The assault would be done by the 120 Royal Marines of Zulu Company, 45 Commando, with supporting fire from 105-mm light guns and the Scimitar armored vehicles of C Squadron, the Light Dragoons.

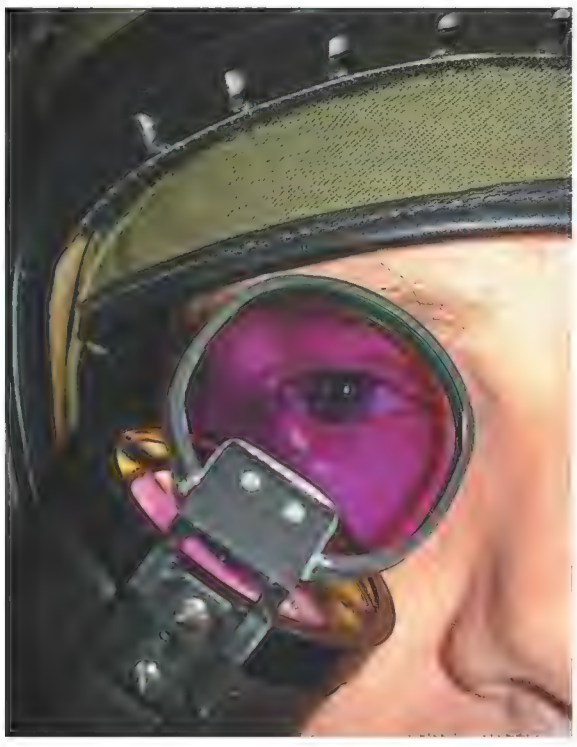
Colonel Magowan, commander of an intelligence unit, planned the operation, and it was an excellent one.

First, the place would be pummeled relentlessly with a massive bombardment from fast air and artillery. It would begin at midnight and last for four hours. An incredible total of 100,000 pounds of bombs dropped by B-1s would test the Taliban's resolve. If they still wanted to stay around and defend it after that, the fort would be every bit as significant as the colonel thought.

Then, at 4 a.m., he would launch a ground assault, move into the fort, and effectively plant an International Security Assistance Force flag on its ramparts—a red flag to the Taliban's raging bull. They would counter-attack with all available manpower—probably with their trademark encirclement maneuver. Zulu Company would then withdraw swiftly just before dawn—leaving the Taliban fully exposed. Magowan's *pièce de résistance* would be to send in the Apaches (call signs Ugly Five Two and Ugly Five Three) to pick them off and identify any hidden bunkers they attempted to escape into, so fast air could close them down—forever.

We were flying the Westland WAH-64 Apache, a British modification of the Boeing Apache Longbow equipped with two 2,100-shaft-

In southern Afghanistan, where it's difficult to tell friend from foe, Taliban commanders could be overheard in radio transmissions exhorting their soldiers to capture a coveted Apache: "I want you to bring down a Mosquito."



COURTESY ED MACY

An Apache pilot's monocle gets readings from a dozen instruments.

horsepower Rolls-Royce engines. Most impressive of all the Apache's cutting-edge technology was how it found its prey. Its Target Acquisition and Designation Sight system (TADS) was made up of an array of cameras housed in a double-headed nose cone that looked like a pair of giant insect eyes. At night, the thermal camera was so powerful it could identify a human form from a distance of four kilometers [2.5 miles], and spots of blood on the ground from a kilometer up.

The TADS monocle sat permanently over a pilot's right iris, and a dozen different instrument readings from around the cockpit were projected into it. At the flick of a button, a range of other images could also be superimposed underneath the green glow of the instrument symbology, replicating the TADS' camera images and the Longbow Radars' targets.

The monocle left the pilot's left eye free to look outside the cockpit, saving him the few seconds that it took to look down at the instruments, then up again—seconds that could mean the difference between our death and our enemy's. New pilots suffered terrible headaches as the left and right eye competed for dominance. They started within minutes, long before takeoff. If you admitted to them, the instructor grounded you immediately—so none of us ever did.

As the eyes adjusted over the following weeks and months, the headaches took longer to set in. It was a year before mine disappeared altogether. During a sortie I once filmed my face with a video camera as an experiment. My eyes whirled independently of each other throughout, like a man possessed.

"That's disgusting," my wife Emily said when I showed her the tape. "But does it mean you can read two books at once?"

I tried it. I could.

I WOULD REMAIN BEHIND, stationed at the base as part of the incident response team. Judging by the amount of stuff they were going to be chucking at Op Glacier 2's target before the assault, we reckoned that there was only a slim chance that the four of us would have anything to do with it.

But at 7:05 a.m., the radio crackled into action. In 20 seconds we were in the Ops room. The watchkeeper was waiting for us.

"It's a casualty evacuation, guys. A single Apache to protect a CH-47 down to Garmsir." He gave me a grid with the Chinook's landing site.

"How many casualties?"

"Five."

That wasn't good. They shouldn't be taking casualties more than three hours after the ground assault was supposed to have gone in.

"Why aren't the two Apaches down there going to protect the CH-47?"

"They're busy fighting."

The Taliban weren't giving up Jugroom Fort without a fight.

I ran the final 500 meters to the flightline. Carl, the pilot, threw forward the engine power levers and our rotors began to turn. A minute later, he radioed the Ops Room.

"Ugly Five One, ready."

"Ugly Five One, this is Ops. You will be joined by Ugly Five Zero. You are now going to RIP [relief in place] with Five Two and Five Three down in Garmsir. RIP time is 0820 hours."

We rarely did unplanned RIPs on deliberate attacks. There just weren't the spare aircraft or crews. It meant only one thing: Life was under immediate threat down there.

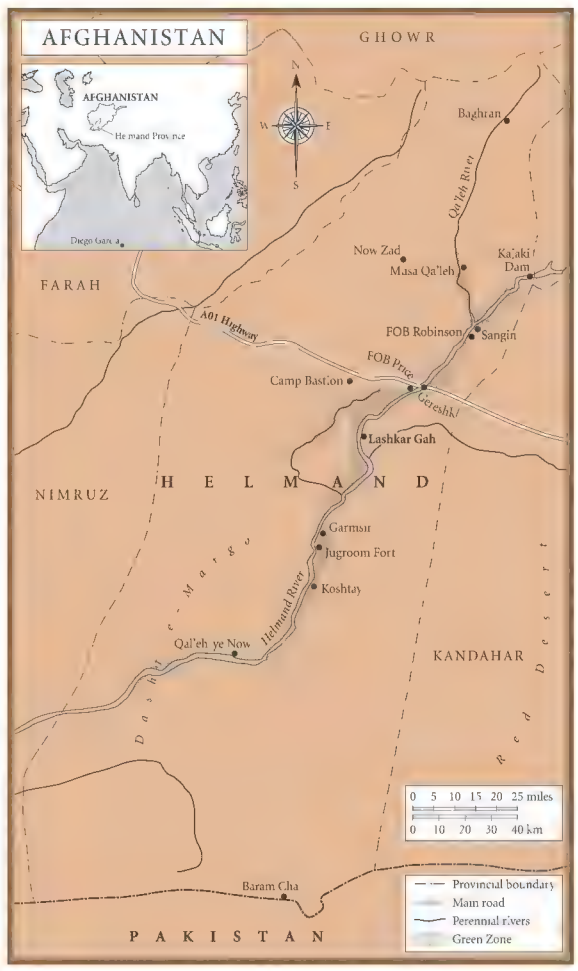
Billy and Geordie, the second Apache crew, flashed up in record quick time: "Ugly Five Zero flight airborne at 0801 hours."

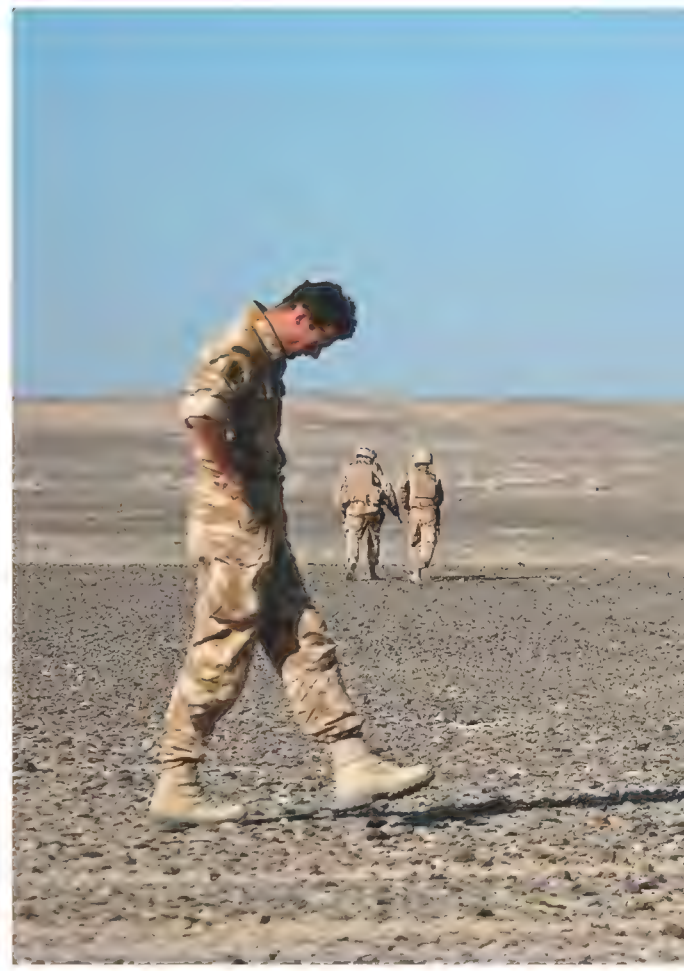
Fifteen minutes into the flight, the Chinook shot right under us on the way back. It was a mighty quick turnaround, and they were bombing it, flying low and straight. It meant the casualties were in a bad way.

At 15 miles to go, I checked in with Widow Seven One, the Joint Terminal Attack Controller, or JTAC. "Widow Seven One, this is Ugly Five One, how do you read?"

"Ugly Five One, this is Widow Seven One. No longer five casualties. Now four casualties and one MIA."

I felt the rush of adrenaline, and the all-too-familiar taste of metal flooded into





The rescue will be featured on the Smithsonian Channel; visit Smithsonianchannel.com.

my mouth. It was preparing me for fear.

"All other troops have withdrawn, but the MIA is still the objective. Repeat, the MIA is *still* the objective."

I tried to think it through. How the hell had they lost someone at the fort, and then all withdrawn without him? The Taliban were clearly still holding the place. Now they might have one of our guys too.

Widow Seven One checked back in. "Ugly Five Two flight have only got enough fuel left for a direct flight back to base. They're going off station now. We need you on station immediately to help locate the MIA. Send ETA."

"Ugly will be with you in 10 minutes."

From Ugly Five Two we learned what had happened. The ground assault was delayed, and didn't go in until just before 7:00 a.m. The marines' 12-strong column of Viking tracked armored vehicles crossed the river, but dawn was already breaking. Their vehicles stopped in a line adjacent to the point where one of the B-1's 2,000-pound bombs had blown a gaping hole in the fort's southern outer wall.

As soon as the marines got to the wall, five of them were hit by machine gun fire. Small arms and rocket-propelled grenade fire cascaded down the canal and from the village to the west. It was mayhem.

Ugly Five Two continued. "The first we knew of the MIA was a few minutes ago, after we pulled off target. He was one of the casualties. We've no idea where he is or how it happened."

"That's all copied. Thanks."

"Ford—that's the MIA's name. Lance Corporal Mathew Ford. Good luck guys. I'm sorry."

He had nothing to apologize for. Getting the marines out of that hornets' nest without any more casualties was a miracle in itself.

Colonel Magowan now faced every commander's worst nightmare. There was no point in the marines going back in without knowing where Lance Corporal Ford was. With the fire from the fort and the surrounding villages, a search would have been suicide. The marines were still firing from the ridge in a desperate attempt to suppress the enemy. It was all they could do for Ford until they knew where he was.

Plumes of dark smoke were now clearly visible on the horizon directly in front of us. The Taliban would try to get Ford into a building and obscure him from our optics as soon as they could.

SGT. GARRY STANTON, RAF

Rob Magowan paces a site in Helmand Province (an area roughly the size of West Virginia), where his battle group launched a massive attack on the Taliban.

Mean machine: The helicopter has 70-mm rocket pods (outboard), attach points for 16 Hellfire missiles, and a 30-mm cannon.

GERBAN VAN ES. ARMING TEAMS 3 AND 4: SI HAMBLY

Even though it had only just been announced, Ford had been officially MIA for 30 minutes and word had spread. Every man and his dog was asking what was going on. Widow Eight Three, a second JTAC working with the gunners, was asking for situation reports to better his targeting. I could make out at least three different levels of command on the secure radio, including Zulu Company's commanding officer, Colonel Magowan, and the Helmand Task Force's headquarters in Lashkar Gah.

A Predator unmanned aerial vehicle and a Nimrod MR2 circled somewhere above us. Their downlinks were being pumped into every HQ, fueling the frenzy.

I focused my TADS on the corner wall of the fort. The image gleamed in the bright sunshine. I moved the camera slowly down the towpath south in the direction that Mathew Ford would have aimed to withdraw. Carl saw where my TADS was headed in his monocle and tracked east towards the bomb crater where the wall had been demolished.

Twenty seconds later: "Ed, I've got an unusual shape. It's about 40 meters along the wall, on the southern side."

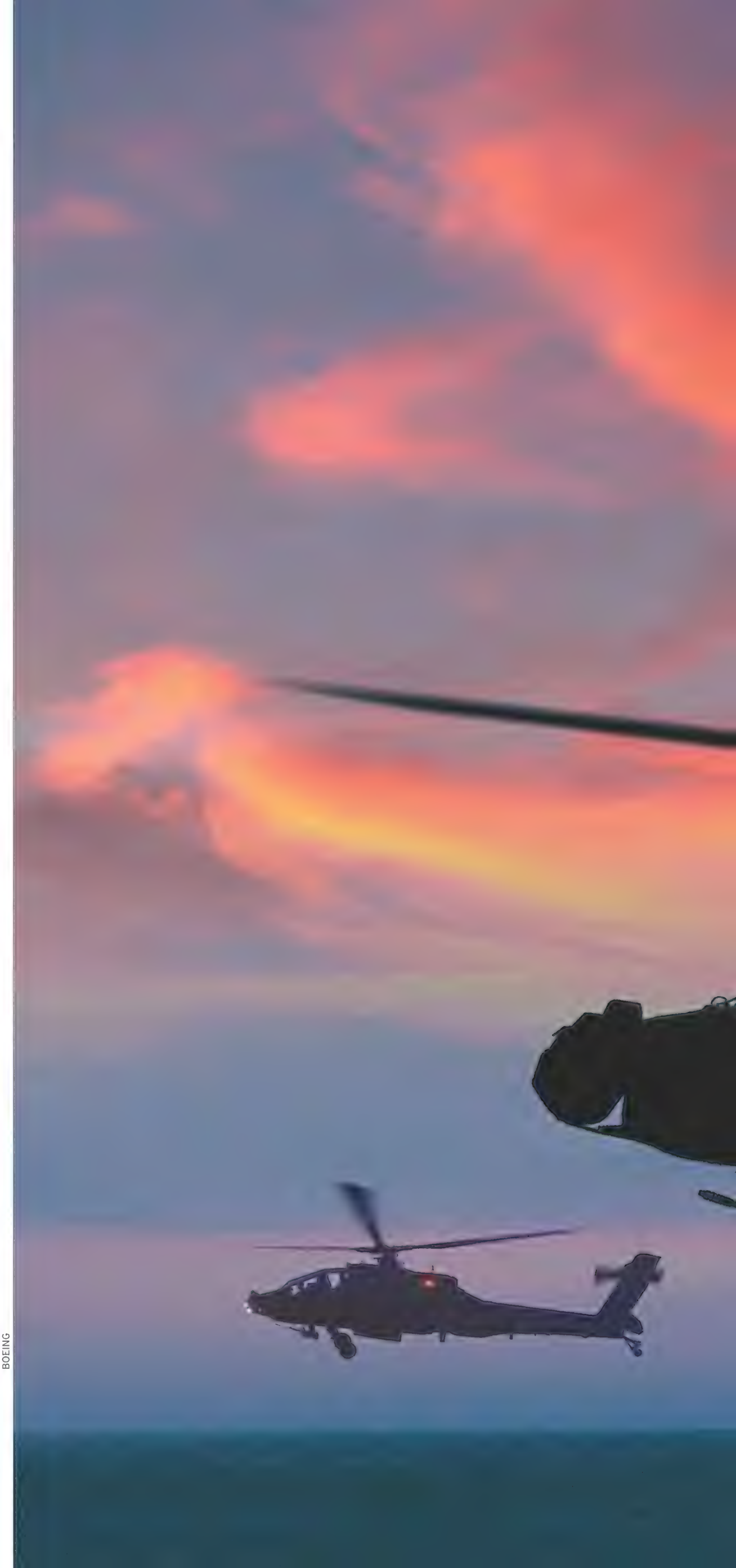
"Okay, stand by."

I shifted the TADS onto Carl's line of sight. A large, S-shaped blob lay sprawled on a raised bank about 10 meters shy of the crater, two feet away from the wall. It looked like a body, lying on its side.

We dropped and I studied the body throughout Carl's 180-degree turn to the northwest. It was lying on its left side, thighs up at 90 degrees to the torso, feet slightly apart, arms outstretched. It was a natural position to lie in, not contorted, and that was a good sign.

We'd found our man. But was he still alive? The moment I announced we'd found him the whole world would want to know.

We came round again, higher. I could not detect any dark patches on his clothing, so no heavy blood loss—as far as we could see. His helmet was on, fastened tight and without deformation. His face was intact, eyes closed and mouth just slightly open. I felt a rush of relief. He



BOEING

The U.S. Apaches (background) fly without their Longbow Radars in Afghanistan and Iraq, swapping their weight for more weapons.

SSGT. CARL BIRD

Looking through a two-inch-thick glass blast fragmentation shield, the rear-seat pilot has a broad view of the terrain.

looked peaceful, as if he was sleeping. No obvious signs of wounding. Had he collapsed through exhaustion? The marines carried an awesome amount of kit into battle these days.

"Ugly Five One, this is Widow Seven One. Is he alive?"

"Ugly Five One can confirm he is warm but has not moved. There are no obvious signs of death; assumption is, he's alive."

An immediate response from a new call sign: "Ugly Five One, this is Wizard."

Wizard? It was the Nimrod MR2, 20,000 feet above. They only relayed messages from way up the food chain. That morning, it was the task force commander.

"Ugly Five One, Sunray says do not let anyone get anywhere near the MIA. Ground troops will re-cross the river and recover Lance Corporal Ford ASAP."

The commander had given the order. The rescue was on.

I called the JTAC and asked for permission to engage the western village, which was still almost entirely intact.

"Ugly Five One, this is Widow Seven One. You're cleared hot onto the village. Destroy the position in preparation for the rescue."

"Copied. The buildings have multiple rooms and look pretty strong. Hellfire may not be best suited. Request fast air to assist ASAP."

"I have called for close air support. Do what you can in the meantime. But do not—I repeat, do *not*—let anyone get near the MIA."

We divided up the workload between the two Apaches. I glanced up from my TADS to see Billy's cannon rounds tearing into the first of the 15 huts and buildings. Billy got off four good 20-round bursts. Every 10 seconds, another three 105-mm shells pounded down on the village. On his second and third runs, Billy planted Hellfires and raked two barn-like buildings with 30-mm, collapsing their stone roofs on the fighters inside.

We swapped over. I could see a series of holes dug into the eastern wall of one of the barns at ground level—little holes a few inches wide, enough to poke a muzzle through. I smacked a Hellfire into the wall and took it down.

Billy broke in as Carl began our third run on the village.

"Ed, I've got an idea. Ford needs to be moved *now*. He's alive, but clearly badly injured. He could be dying right now."

"Affirm."

"Well, we could pick him up."

"Say again?"

"We could rescue him. You stay up, we'll go down. One of us gets out and straps him to the side of the aircraft. You know, like our downed-aircraft emergency drill."

I thought it through. It was ludicrous. I'd picked up unconscious bodies before. There was no way one person could shift Mathew to the Apache and strap him on alone. I consulted Carl and he agreed.

Billy called our commanding officer, Major Christopher James, on the secure frequency-modulated net.

"Negative," was the Boss' response.

I said to Billy, "I've got a better plan. Let's go and collect two marines each and fly them into the fort to collect the casualty. It'll be much quicker. You coordinate the fire plan and 3 Flight can give us top cover."

"Stand by."

I looked at Mathew Ford's body. Strap-

COURTESY ED MACY

The labor-intensive helicopter requires 32 hours of maintenance for every hour flown – and a ground crew of 98.

An Apache fires a pair of rockets across the Afghan sky.

CORPORAL MARK BALLANTYNE RLC; © CROWN COPYRIGHT/MOD

ping someone to the side of the aircraft was an emergency drill only to be used to rescue downed Apache aircrew. We'd rehearsed it as part of our escape-and-evasion training, but only on the ground and never with engines on or the rotors actually turning. That contravened Ministry of Defence health and safety guidelines. In 23 years of Apache operations, the Americans had never lifted any ground troops on the wings.

However, it was theoretically possible. We were all carrying our emergency straps as routine equipment, and the grab bars were right there behind the canopy. The only other aircraft we had available were the Chinooks, and they'd just set off back to base, low on fuel, after dropping more ammo at the gun line. Besides, a great big flying cow like that would get shot down there. Unlike the Apache, it wasn't designed to take rounds.

We were the only airborne option. It *was* possible. Maybe it could work.

That was all Billy needed. He was straight back onto the Boss.

"Listen, sir, the ground troops are nowhere near ready to cross. I want to get two men on each aircraft and fly them into the fort to recover the casualty. Can you send 3 Flight down to assist?"

"Billy, listen to me," the Boss said. "We've been on the phone to headquarters at Lashkar Gah and they have said it will be a ground rescue."

"Okay, sir. If I land, just confirm I will be disobeying a direct order."

"Affirmative. You will be. You can't land both aircraft, you have no top cover."

There was a five-second silence.

Then the Boss came back on. "I am launching 3 Flight to come and assist you. Don't do anything until the other aircraft arrive. I have no situational awareness and you have the bigger picture. If you think it will work, you'll need permission from the ground commander."

I was straight onto Widow Seven One. The JTAC's response was swift. "Negative. That request is denied, Ugly Five One. Zulu Company is going to rescue him."

Widow Seven One had more bad news. "Be advised, Ugly Five One, Zulu Company will be a further 30 minutes. Keep suppressing for their assault."

It was now 9:48 a.m., and we'd been on station for an hour and 11 minutes. It wasn't just our ammunition that was running out. At 10:02 a.m., Carl called "Bingo." We were running low on gas. In 30 minutes we'd only have enough fuel left to get back to base.

We looped over the firebase and took a peek at Zulu Company. They were sitting on their rucksacks, waiting for the order.

It was time to talk to Colonel Magowan. As we spoke, it dawned on me that this was the first time Magowan had heard of our plan. I explained the whole thing as succinctly as I could.

"Give me two minutes to think."

"We don't have two minutes, sir."

"Give me 20 seconds then."

Utter silence. For the first time all day, the mission radio net went quiet. Half of Helmand province was listening in now, and everybody was waiting for Magowan's answer.

"Ugly Five One, this is Magowan. Your plan is approved."

We headed for the command post, six kilometers west of the fort. Four volunteers were waiting. I grabbed the first man I reached and pulled him up to the right side of the aircraft while I pulled out my strap.

"You've got to strap yourself on because if you get shot while you're on the wing, you need to stay on it. Lots of things might happen out there. I'm not going to go into them all."

I pointed to the grab bar beside Carl's door.

"This bar here is what you're going to strap onto."

I demonstrated. We were one strap short. I went around to the fourth man.

"There's no strap for you."

He looked at me in disbelief.

"Put your arm through the grab bar and force your hand in under your body armor. That way you won't fall off if you get shot. Do you understand what I'm saying?"

Carl pulled on the collective and we began to lift steadily into our own swirling dust cloud. The plan was simple. The B-1's 2,000-pound bomb would kill most of the Taliban in the village and stun the rest. After the B-1 dropped his bomb, we'd have two minutes on the ground. Thirty seconds to get to Mathew, a minute to get him back, and 30 seconds to tie him onto the aircraft.

Yes, it was doable.

SECRET

Space Shuttles

THE GIANT GOLD AND SILVER SATELLITE glittered against the black sky as space shuttle *Atlantis* closed in on it from below. Commander Hoot Gibson and pilot Guy Gardner flew the approach, while mission specialist Mike Mullane, at the other end of the flight deck, readied the shuttle's robot arm for a capture. Downstairs in the airlock, mission specialists Jerry Ross and Bill Shepherd waited in their spacesuits for Gibson's order to go outside and attempt a rescue.

What happened (or didn't) on those classified missions?

BY MICHAEL CASSUTT

The mission of STS-27 had been to deploy the first in a series of new spy satellites that used radar to observe ground targets, in any kind of weather, day or night. But shortly after the astronauts released the spacecraft, called ONYX, from the shuttle's cargo bay, on December 2, 1988, one of its antenna dishes had failed to open. Without intervention by the crew, the billion-dollar satellite would become a hunk of space junk. As it turned out, they succeeded in grabbing, fixing, and re-releasing ONYX, for which they later received a medal from the U.S. intelligence community.

At least that's one possible scenario for what happened. The astronauts may just as well have fixed the satellite without a spacewalk by Ross and Shepherd. We don't know because not a word of the ONYX rescue was reported in newspapers or on television. Why not?

Because STS-27 was—and remains—a secret mission.

Between 1982 and 1992, NASA launched 11 shuttle flights with classified payloads, honoring a deal that dated to 1969, when the National Reconnaissance Office—an organization so secret its name could not be published at the time—requested certain changes to the design of NASA's new space transportation system. The NRO built and operated large, expensive reconnaissance satellites, and it wanted a bigger shuttle cargo bay than NASA had planned. The spysat agency also wanted the option to fly "once around" polar missions, which demanded more flexibility to maneuver for a landing that could be on either side of the vehicle's ground track.

"NRO requirements drove the shuttle design," says Parker Temple, a historian who served on the policy staff of the secretary of the Air Force and later with the NRO's office within the Central Intelligence Agency. The Air Force signed on to use the shuttle too, and in 1979 started building a launch pad at Vandenberg Air Force Base in northern California for reaching polar orbits. Neither the Air Force nor the NRO was ever comfortable relying exclusively on NASA's vehicle, however. Delays in shuttle launches only increased their worry; even before the 1986 *Challenger* accident, they were looking for a way off the shuttle and back onto conventional rockets like the Titan.

The uneasy relationship between the Air Force, NRO, and NASA assumed a human face in 1979, when the military chose its first group of shuttle astronauts. Two years before the shuttle's first launch, the NRO selected 13 Manned Spaceflight Engineers as potential payload specialists, all but one from the Air Force. The new military astronauts ranged in age from 24 to 36. Most had advanced degrees in engineering; one was a Ph.D. They were experienced in satellite flying and acquisition. And they believed they were the vanguard of the Air Force in space.

Only one of that first group ever made it to orbit.

Paul Sefchek, one of those who didn't (he retired from the Air Force in 1989 and died in 1997 at the age of 51), told me in an interview years ago that his colleagues were like "old Army scouts who were sort of aimed at NASA by the Air Force and told to find out whatever they could find out. They returned to the fort bleeding and full of wounds."

One fundamental problem was how the two agencies perceived "payload specialists." NASA thought of them as outsiders, almost guests—engineers or scientists who tended one particular satellite or experiment, and typically flew just once. The MSEs thought their job was to help bridge the gulf between the military and civilian space agencies.

It didn't work. Gary Payton, now deputy undersecretary of the Air Force for space, is the only one of the first group of military astronauts to fly; he recalls, "I was naive enough to believe that the payload side would be treated by NASA the same way the Air Force launch people treated us. In the world I came from, payload requirements would drive the time of day you launched, the

The crew of mission STS-27 (opposite, during preflight training, and on their way to orbit in December 1988) couldn't talk about what they did in space until five years after their return. Even today, they can't give details.

ALL PHOTOGRAPHS: NASA

time of year, everything. In 1980, NASA was still worried about getting the shuttle to fly. So we were not paid much attention to. It was a rude awakening."

In addition to cultural differences, there were plain old turf battles. According to Dave Vidrine, director of the military astronaut program in the early 1980s, one eager MSE, whom he didn't want to name for publication, was "coming up with a lot of new projects and carving out his own turf." On one occasion, NASA astronaut Ellison Onizuka was training underwater at the Johnson Space Center for a spacewalk when the MSE, a qualified scuba diver, decided he needed to measure a piece of equipment. He and another member of the Air Force team in Houston jumped into the training pool and went to work. The NASA test conductor spotted the two unauthorized divers and ordered them out of the pool. A shouting match ensued, and the offending MSE was banned temporarily from the center.

T.K. (Ken) Mattingly, an Apollo-era astronaut who also reached the rank of rear admiral before retiring from the Navy in 1989, commanded the shuttle's fourth mission, in June 1982, which carried the program's first classified payload. He describes the relationship between the NASA astronauts and the MSEs in those early days as "sour."

Nor did the MSEs have much support within the Pentagon. Jeff DeTroye, one of the first 13 military astronauts, was assigned to escort General Lew Allen, Air Force chief of staff, during a visit to Los Angeles for the 20th anniversary of the NRO in 1981. Upon learning of DeTroye's involvement in the shuttle, Allen was blunt. He had played "a primary role in canceling the Manned Orbiting Laboratory [a proposed military space station of the 1960s], and had he had his way, would have canceled the shuttle," DeTroye says. Allen made it clear he thought there was no role for man in space, period, according to DeTroye.

Mattingly says, "I sometimes thought the only people in the Air Force really interested in the shuttle were the MSEs."

STILL, THE CLASSIFIED PAYLOADS had to be launched—not just on the secret flights, but as secondary payloads on NASA-sponsored shuttle flights too. Once the two sides started working together on actual missions, things improved, according to Payton, who was part of the support team for Mattingly's STS-4 flight. "We found that once the shuttle had flown, there were people inside NASA who were eager to satisfy military requirements," he remembers. "We saw that the [NASA] folks were pretty damn good!"

On the other hand, the STS-4 payload, identified only as "P82-1," didn't impress Mattingly. "It was a rinky-dink collection of minor stuff they wanted to fly," he recalls. P82-1 turned out to be the Cryonic InfraRed Radiance Instrumentation for Shuttle (CIRRIS) and the Ultraviolet Horizon Scanner (UHS), two sensors designed to test missile detection from space. A cover failed to open, so neither worked.

The main cargo on STS-44 was a Defense Support Program satellite (above) for early warning of missile launches. The crew conducted an Army experiment called Terra Scout to test their skill as orbital observers.

The Air Force-NRO control center for shuttle missions was located in Sunnyvale, California. While Houston and *Columbia* conversed frequently, no one had come up with a way to re-

fer to the classified control center over the open channel. Payload communicator DeTroye recalled a last-minute panic about the mere mention of "Sunnyvale." "What were we supposed to say? '*Columbia*, this is...Saratoga'? I can't imagine what [Mattingly] would have done if he'd heard that."

The use of code words occasionally got comical. On the seventh day of the mission, Mattingly and pilot Hank Hartsfield were getting ready to return to Earth and had just stored the classified checklists in *Columbia*'s safe. Sunnyvale then asked them to perform "Tab Echo." The astronauts looked at each other; neither could remember what Tab Echo was. They opened the safe, removed the checklist, and began paging through it. Sure enough, there was Tab Echo: "Store checklist."

THE MILITARY ASTRONAUTS FELT LIKE "OLD ARMY SCOUTS WHO WERE AIMED AT NASA BY THE AIR FORCE AND TOLD TO FIND OUT WHATEVER THEY COULD FIND OUT. THEY RETURNED TO THE FORT BLEEDING AND FULL OF WOUNDS."

A few years later, when NASA astronaut Kathy Thornton was preparing for her classified mission, STS-33, "training schedules were coded," she recalls. "They would say things like 'Event 7012.' You had to open up the safe every morning to find out that Event 7012 was food tasting in another building, and you were already five minutes late."

After STS-4, an ambitious schedule of military missions loomed, and in 1982 the Air Force recruited 14 more MSEs. But the first fully classified flight, STS-10, got delayed due to problems with the new Air Force-built Inertial Upper Stage, used to boost satellites to their designated orbit. Other military experiments flew on NASA missions in the meantime. On flight STS-41G, launched in October 1984, the crew conducted a satellite refueling test "hatched by some Air Force general," according to journalist Henry S.F. Cooper Jr. in his 1986 book *Before Liftoff*. Oceanographer Paul Scully-Power was also on board, observing ship wakes on the surface of the sea for the U.S. Navy.

Meanwhile, the crew of STS-10 (renamed STS-51C and commanded by Mattingly) continued to train, all the while pioneering the security procedures that classified missions mandated. A ready room was set up in the astronaut office, complete with a secure telephone that had a secret number. "If certain people need to get hold of you," Mattingly was told, "they'll call." The phone rang just once: The caller asked if Mattingly was interested in subscribing to MCI long distance service.

Another time, Mattingly and three STS-51C crewmates—Onizuka, Loren Shriver, and Jim Buchli—had to take a trip to Sunnyvale. The astronauts were ordered to disguise their destination by filing a flight plan for Denver, then diverting to the San Francisco Bay area. They landed their T-38s at NASA's Ames Research Center in Mountain View, rented a "junky old car that could hardly run," according to Mattingly, and drove to an out-of-the-way motel arranged by their secretary. As they pulled up, Buchli, in the back seat, called a halt. "We made extra stops to make sure we wouldn't come here directly," he said. "We didn't tell our families, we didn't tell anybody where we are. Look at that motel." On the marquee was written "Welcome STS-51C Astronauts," with all four names in big type.

All five NASA astronauts on the classified STS-28 mission had military backgrounds. But only two of the defense department's corps of 27 shuttle payload specialists made it to orbit.

Mattingly's crew—including MSE payload specialist Payton—finally got off the ground in January 1985. For the first time in NASA history, there was no pre-launch public affairs commentary until nine minutes before liftoff. During the flight, the Air Force lifted the veil of secrecy only to admit that the payload was successfully deployed, and that an Inertial Upper Stage was used.

According to most accounts, STS-51C's payload was ORION, an eavesdropping satellite for signals intelligence. Parked in geosynchronous orbit, it unfurled a dish almost as wide as a football field is long (hence the need for the shuttle's large payload bay) to listen in on ground communications and telemetry. No one involved with the mission will comment beyond this recent statement from Payton: "It's still up there, and still operating."

The second dedicated military flight was STS-51J, the following October. Karol Bobko commanded the crew of five, and Bill Pailes, a member of the second military astronaut group, was on board as a payload specialist. Even before the launch, outside analysts deduced that *Atlantis* would release a pair of Defense Satellite Communications System spacecraft in orbit.

When STS-51J landed, the first launch from the new west coast shuttle pad at Vandenberg was just a year away. The mission, STS-62A, was to have been commanded by four-time shuttle astronaut Robert Crippen, with Air Force undersecretary Edward "Pete" Aldridge and MSE Brett Watterson along as payload specialists.

Then came the 1986 *Challenger* accident. As NASA struggled to return the shuttle to flight, the Air Force and NRO sped up their plans to move payloads back to unmanned rockets. The only satellites that would still be launched on NASA's shuttle were those that couldn't be shifted to the Titan IV.

When the military abandoned the shuttle, MSEs like Frank Casserino and Watterson suddenly lost their flights. By 1988—the year NASA returned the shuttle to service—the military astronaut corps had disbanded, its members scattered to new assignments. (Of the 27 officers in the first two MSE groups, five would later become generals.)

The remaining classified flights fell to NASA astronauts. The first post-*Challenger* military mission was STS-27, whose crew rescued the ONYX satellite. Then came STS-28 in August 1989, which analysts assumed at the time—based on its 57-degree orbit that overflew a large percentage of the Earth—carried another imaging satellite. Years later, the sleuths determined that STS-28 had instead carried a Satellite Data System spacecraft for relaying imagery from NRO spy satellites. (That conclusion was confirmed for me by an Air Force officer familiar with the mission, who upon seeing CBS news footage of the NRO satellites in 1998 said, "It's strange to work on a secret project for 10 years, then see it on network television.")

"TRAINING SCHEDULES WERE CODED. THEY WOULD SAY THINGS LIKE 'EVENT 7012.' YOU HAD TO OPEN UP THE SAFE EVERY MORNING TO FIND OUT THAT EVENT 7012 WAS FOOD TASTING IN ANOTHER BUILDING, AND YOU WERE ALREADY FIVE MINUTES LATE."

The next classified mission was STS-33, in November 1989. *Discovery*'s crew was commanded by Fred Gregory, with John Blaha as pilot and three mission specialists: veteran astronaut Story Musgrave, Sonny Carter, and Kathy Thornton. Musgrave and Thornton (who had once worked as a scientist for the Army) were the only civilians ever assigned to secret missions. In orbit over Thanksgiving, the crew of STS-33 was able to conduct its mission with limited public scrutiny. The Air Force admitted only that the astronauts deployed a spacecraft using the Inertial Upper Stage; the payload is believed to have been the second ORION eavesdropping satellite.

In the 1990s most shuttle missions, like STS-44 (shown here over China), orbited at low latitudes. Military shuttles occasionally ventured as high as the Arctic Circle.

The cargo for the next classified flight, STS-36 in February 1990, was harder for ground-based sleuths to figure out. The mission was unusual for its highly inclined orbit—62 degrees, still a shuttle record—which took the crew well above the Arctic Circle and far enough south that they could glimpse the coast of Antarctica. The industry magazine *Aviation Week & Space Technology* reported the payload's name as "AFP-731" and its weight as 37,000 pounds. For years it was thought to have been an advanced KH-11 imaging satellite; not long after *Atlantis*' return, the Soviet news agency Novosti reported that the satellite had "malfunctioned," and that large pieces of debris were being tracked prior to reentry.

Wrong, says author Jeffrey Richelson, whose credits include books on the Defense Support Program (DSP) early warning satellites and *The Wizards of Langley*, a 2001 history of technical innovation at the CIA. In the latter book he claims that STS-36 deployed a stealthy reconnaissance satellite named MISTY. The "debris" had likely been jettisoned shrouds or instrument covers. Stealthy or not, the satellite was eventually spotted by amateur trackers in a roughly 500-mile-altitude orbit at a 65-degree inclination.

The November 1990 flight of STS-38 presented another puzzle for spysat detectives. Its trajectory east of Cape Canaveral initially pointed toward a third ORION eavesdropping satellite, but NRO information released eight years later indicates that it might have been a data relay satellite. Richelson has suggested that in

addition, STS-38 carried a small "inspector" satellite designed to get close to other spacecraft in geosynchronous orbit. That scenario is still being debated.

WITH THE LAUNCH OF STS-39 in April 1991, the Department of Defense began to lift the veil on its shuttle operations. The mission was declassified before launch, and NASA was allowed to reveal that it carried a military-sponsored pallet called AFP-675, a reflight of the payload flown years earlier on Mattingly's STS-4 mission.

Which is not to say that STS-39 didn't have secrets. One day, according to a member of the crew, another astronaut, Guy Bluford, "went up on the aft flight deck by himself while the rest of us pretended not to notice." Bluford launched a small classified satellite, purpose still undisclosed.

The STS-33 crew, led by Fred Gregory (above), included two civilians – the only ones ever to fly on a secret shuttle. The STS-51C crew, which flew the first classified mission (left, during launch emergency training), included Gary Payton. Today he's a high-ranking Air Force official.

The trend toward declassification continued with STS-44 in November 1991. Months before the launch, the Air Force acknowledged that *Atlantis* would carry the 16th DSP satellite for early warning of missile launches. Also on board were some secondary experiments and Army intelligence specialist Thomas Hennen, who flew in space to observe military targets on the ground, under a program known as Terra Scout.

The following year, the existence of the National Reconnaissance Office was officially revealed, just as the queue of secret shuttle payloads wound down to the end. The last dedicated military mission, STS-53, flew in December 1992, carrying a satellite identified as DOD-1, which Richelson and other analysts surmise was another data relay vehicle.

NASA closed the secure control room at JSC in Houston and the equally secure Firing Room 4 at the Kennedy Space Center. The cadre of Air Force support personnel was dispersed. And that brought to an end the sometimes testy, always mysterious relationship between NASA and the Air Force/NRO, which had figured so prominently in the middle decade of the shuttle's nearly-30-year history.

In 1993, a person identified publicly only as a "high-ranking intelligence official" traveled from Washington to the Johnson Space Center to meet with all the astronauts who had flown secret shuttles and present them with National Intelligence Achievement Medals. At that time, each astronaut was officially cleared to wear the medal in public and to acknowledge the facts written on the citation. Hoot Gibson, for example, could now disclose that he had "returned to" STS-27's satellite payload, and that the mission specialist on that flight, Mike Mullane, had used the shuttle's robot arm. Sixteen years later, those brief citations provide almost the only official details of what happened.

Today, the astronauts remain bound to silence. Says Mattingly, "The accomplishments were first-class. I would give anything if someone would say, 'Here's what we did. You should be proud of it.' "

As for the Ross-Shepherd spacewalk on STS-27, we still can't say for certain that it happened. There is another clue, however. On February 14, 2001, astronauts Tom Jones and Robert Curbeam were in the middle of their third spacewalk of space station assembly mission STS-98. NASA public affairs had advertised it beforehand as the 100th American spacewalk. But just as the astronauts were about to say something to mark the event, pilot Mark Polansky radioed them on a private channel to warn them off. According to Jones' 2006 memoir, *Skywalking*, "Somebody had done a recount, and discovered that the real 100th EVA [extravehicular activity] had been two days ago on EVA-2."

How could that happen? Had there been a secret spacewalk that never made it into the official tally?

Maybe someday we'll all be cleared to know.

From Pilot to President

YOU CAN LEARN A LOT ABOUT A LEADER BY LOOKING IN HIS LOGBOOK. BY BARRETT TILLMAN

THESE PILOTS FLEW HIGH in the cockpit, and then in politics. Some reached their positions of leadership through the democratic process, others got there through royal birth, and some, of course, simply seized power. A few crashed and burned in both jobs.

Few countries have produced as many flying commanders-in-chief as the United States. The first to earn a pilot's license was Dwight Eisenhower, who soloed in 1937, when he was a lieutenant colonel serving in the Philippines. But he never qualified for Army wings.

When it came to the right stuff, which of these leaders—and the list is by no means complete—were legit as aviators? Here are their qualifications:

It is George H.W. Bush, president from 1988 to 1992 and one of the youngest naval aviators of World War II, who has the most impressive record of America's pilot-presidents. Not quite 19 upon receiving his wings, he flew TBM Avenger torpedo bombers from the carrier USS *San Jacinto* in 1944. It was said that Bush was "one of Grumman's best customers," having ditched one Avenger with engine trouble and parachuted from another. On a mission over the Bonin Islands, Japanese flak set Bush's Avenger afire. He remained airborne long enough to reach open water. Though his two crewmen perished after bailing out with Bush, the future president was rescued by submarine. After the war, told that the Japanese army routinely cannibalized captured fliers, Bush quipped that he was so thin he would have made a poor meal. For his 58 combat missions, Lieutenant Junior Grade Bush was awarded the Distinguished Flying Cross and three Air Medals.

Young man on a mission: A baby-faced George H.W. Bush (above), shown in 1943-44, flew the Grumman TBM Avenger in the Pacific. Half a lifetime later, he would land in the Oval Office.

GEORGE BUSH PRESIDENTIAL LIBRARY AND MUSEUM

The U.S. Air Force took Jordan's King Hussein (left) for a hop in a Lockheed F-104 Starfighter during his visit to the United States in 1959. Prince William (below) flies helos for the British army. He's shown here in January 2008 on a four-month stint with the Royal Air Force.

Addendum: His son George W. Bush, president from 2000 to 2008, briefly flew Convair F-102 interceptors while serving in the Texas Air National Guard from 1968 to 1974, but didn't see combat.

Britain's royal family's got air cred. Though George V, king from 1910 to 1936, was photographed in Royal Air Force uniform with only honorary wings, three of his heirs earned pilot ratings. His second son, Prince Albert, saw combat in the Royal Navy, then entered the fledgling RAF in 1918 as a non-flying officer. Shortly after World War I, he trained to fly. Albert's older brother Edward and younger brother George also became skillful pilots.

Edward inherited the throne in 1936 and established the King's Flight at Hendon, where he became Britain's first reigning monarch to fly as passenger and pilot. When Edward abdicated to marry an American divorcee, Wallis Simpson, Albert succeeded with the name George VI. Baby brother George died in the 1942 crash of a Sunderland flying boat.

More recently, Prince Charles earned his wings in 1971, then qualified in helicopters in 1974. His son, Prince William, has flown in the RAF and the British army, primarily as a pilot on search-and-rescue choppers. Charles' brother Andrew flew Sea King helicopters from HMS *Invincible* in the 1982 Falklands War, and continued flying until 1996.

Ian Smith, prime minister of Rhodesia (now Zimbabwe) from 1965 to 1979, was based in Egypt in October 1943 when he crashed on takeoff in his Hawker Hurricane. He broke facial bones, a leg, and a shoulder, and bowed his spine.

After reconstructive surgery, Smith was recertified and, owing to damage to his left eye, offered an instructor's post. He declined, preferring combat, and flew Spitfires with No. 237 Squadron out of Corsica. In July 1944, strafing German forces in Italy's Po River Valley, Smith was hit by flak and bailed out. He spent five months with the underground, helping coordinate Allied air operations, before embarking on a 23-day trek over the Alps to safety. He died in 2007 at age 88.

King Hussein bin Talal of Jordan formally ascended the throne in 1953 at age 17. He learned to fly his grandfather's De Havilland Dove, and reportedly escaped two Syrian MiGs with low-level evasive maneuvers over Syria in 1958, just before his 23rd birthday. Hussein relied upon Britain's RAF for early training, and with his guidance, the Royal Jordanian Air Force improved. But it lacked the skill of Israel's air force, which decimated the RJAF on the ground in the 1967 Six Day War.

When making state visits, Hussein often took the controls of his Boeing 707, though with a full crew aboard. And he established a flight demonstration team with Canadian Dave Rahm and American Steve Wolf, which later became all-Jordanian. Flying Pitts

TOP: AP PHOTO/HAROLD FILAN; BOTTOM: AP PHOTO/KRISTY WIGGLESWORTH

Former Israeli president Ezer Weizman (right) sits in a British Spitfire, an airplane that he flew in World War II, on a visit to England in 1995. In 1993, he took the helm in Tel Aviv.

Specials, the duo appeared in 1976, but Rahm was killed the next year in a performance in Jordan with Hussein in attendance. Hussein pressed ahead, and the Royal Jordanian Falcons debuted in 1978, sponsored by Jordan's national airline.

Hussein remained an avid flyboy until his death in 1999. His son, Abdullah, who took over the throne, is also a pilot.

Egyptian president Hosni Mubarak graduated from the country's military academy at age 20 in 1949. He entered the air academy and took the standard curriculum of flying, along with scientific and technical studies. With a bachelor's degree in aviation science, he flew fighters, then bombers.

Egypt got much of its operational training from the Soviet Union, where Mubarak qualified on Il-28s (NATO name: Beagles) and later Tu-16 Badgers. He became an instructor and unit commander, and in 1964 headed a military delegation to Moscow. At home he earned a reputation as a crack operations officer and planner.

After the 1967 war with Israel, Mubarak rebuilt the air force with an emphasis on training. As air force commander he waged the far more successful October 1973 war with Israel. Under his watch, in 1979 the Egyptian air force received its first F-4 Phantoms. Today the EAF inventory is about 30 percent American, including F-4s, F-16s, C-130s, E-2 Hawkeyes, and Apache helicopters.

After Anwar Sadat was assassinated in 1981, Mubarak became president, declaring an open-ended state of emergency that continues.

Dashing around in a Spanish air force F/A-18B Hornet in 1997, or just plain dashing, Prince Felipe of Spain (below) has it all. These days he's a family man, tomorrow a king.

Israeli Ezer Weizman entered the British Army during World War II and flew in France and India. He studied aeronautics in Britain and returned home to fly in Israel's 1948 war of independence. He also flew in a 1949 skirmish pitting Israeli Spitfires against RAF counterparts. Weizman commanded one of Israel's first jet squadrons, then rose to lead the air force from 1958 to 1966. His role in planning the spectacular 1967 war against Egypt, Jordan, and Syria cemented his pilot credentials.

Weizman was far from politically correct, and once told a woman who wished to enter flight training that females were better off darning socks. She appealed to Israel's high court and received permission to take the air force's pilot entrance examination, but failed her medical tests.

Elected president in 1993, Weizman re-

LEFT: AP PHOTO/EFE, JAVIER ZEBOLLADA; TOP: AP PHOTO/FINDLAY KEMBER; OPPOSITE: AP PHOTO/MICHEL LIPSCHITZ

signed in 2000 amid charges of unreported income. His peace efforts with the Palestinian Authority did not help his case among hardliners in his conservative Likud party. But he remained a pilot's pilot, and flew his shiny black Spitfire after most of his fellow jockeys had retired. Weizman died at age 80 in 2005.

South Vietnam's Nguyen Cao Ky trained to be a pilot in France and North Africa in the 1950s, attended the U.S. Air Command and Staff College, and, in 1964 became head of Saigon's air force at age 34. Often sporting a lavender scarf and aviator sunglasses, as well as a pearl-handled revolver on his hip and a cigarette in his mouth, he flew Douglas A-1 Skyraiders. His young wife attracted equal attention in a form-fitting black flightsuit that matched his.

In 1963, Ky supported the Kennedy administration's coup that overthrew Prime Minister Ngo Dinh Diem and was rewarded with promotion to air marshal. He was later appointed prime minister and remained head of the air force through 1967. In 1975, he moved to the United States, settled in Los Angeles with his glamorous third wife, and opened a liquor store, prompting wags to opine that he had realized the dream of aviators everywhere.

Certainly the most junior airman to lead his country was Flight Lieutenant (the equivalent of U.S. Air Force first lieutenant) Jeremiah "Jerry" Rawlings of Ghana, whose titles include "Twice Head of State" and "First President of the Fourth Republic." In 1967, he enlisted as a flight cadet in Ghana's air force, and was later selected for officer training. An accomplished airman, Rawlings received the Speed Bird Trophy in 1969 for top flying grades in his class.

Rawlings was no less accomplished on the ground. In 1979, concerned about systemic corruption, he overthrew his government for the first time at age 32. During the first coup, Rawlings was most often seen wearing a flightsuit and air force hat, though by then the extent of his flying experience remains questionable. Ghana's air force seldom numbered more than 30 aircraft at any time, none of which was combat-capable.

Rawlings toppled his successor in 1981, got himself elected in 1993, and finally left office due to term limits in 2001.

Bolivia's René Barrientos Ortuño, a career military officer, learned to fly in 1945. He owned a Cessna 195 and enjoyed buzzing passenger trains in a military AT-6. In the 1940s, he gravitated toward the Revolutionary Nationalist Movement, and took part in the Bolivian revolution in 1952. He flew Victor Paz Estenssoro, the revolution's leader who had been in exile in Argentina, back into the country, and as a result was given command of Bolivia's air force.

In 1960, during a public air force parachute demonstration, three skydivers fell to their deaths before a horrified crowd. When Barrientos became the target of some of the accusations that followed, he strapped on one of the parachutes that had failed to open and jumped from an airplane. The chute performed properly. Barrientos claimed that his jump proved that nothing was fundamentally wrong with the parachute or his credibility.

He served almost continuously as president from 1964 to 1969, when he died in a helicopter crash.

Prince Felipe of Spain was voted by *People* magazine as the Sexiest Royal in 1997. After years as one of Europe's most eligible bachelors, the 41-year-old heir to the Spanish throne is married and a dad to two daughters. But he's flown the F/A-18 Hornet, and is helicopter-qualified in the army and the navy.

Egypt's Hosni Mubarak (left) sits in a helo trainer at the 1977 Paris Air Show. Still vice president then, he had flown the Soviet Tupolev Tu-16 Badger bomber, and planned the 1973 war with Israel.

Now, if you were born into European royalty, and you asked for the keys to a supersonic fighter, your dad would probably hand them over. Furthermore, while Spanish women might swoon over his six-foot-five height, most air forces would pass on someone that tall, as a tight fit in a fighter cockpit. But Felipe seems legit—with the other Spanish air force cadets in his class, he happily shaved his hair in the shape of a T, a tradition on the day they get their wings.

There are plenty more presidents, prime ministers, monarchs, and dictators with wings. Which ones do you think have had the right stuff, and which ones are mainly stuffing? Send an e-mail to us at *editors@si.edu*.

How Things Work:

Self-Heali

BY TOM LECOMPTE | ILLUSTRATION BY JOHN MACNEIL

WHEN SOVIET DESIGNER ANDREI TUPOLEV COMPLETED THE ANT-20, OR *MAXIM GORKY*, IN 1934, IT WAS NOT ONLY THE WORLD'S LARGEST AIRPLANE, IT WAS AMONG THE MOST INNOVATIVE. HE BUILT THE WINGS WITH CRAWL SPACES SO MECHANICS COULD TINKER WITH THE EIGHT ENGINES LITERALLY ON THE FLY. BY CONTRAST, TODAY'S DESIGNERS ARE ELIMINATING THE HUMAN FROM THE TASK OF MAKING IN-FLIGHT REPAIRS. WITH REVOLUTIONARY MATERIALS, MICRO-ELECTRONIC DEVICES, MICRO-SENSING, AND WIRELESS TECHNOLOGY, TOMORROW'S AIRPLANES WILL REPAIR THEMSELVES.

"A lot of it has to do with advances in polymer composites," says Nancy Sottos, professor of materials science and engineering at the University of Illinois. "How to add structural fibers, pigments, or other ingredients to polymers is well established. We have good control over the surface chemistry."

Sottos and her colleagues in the Autonomous Materials Systems Research Group have been pioneers of self-healing composites, which mimic how plants and animals heal wounds. The researchers have developed tiny capsules of liquid solvent that bleed when the structure cracks, sealing the damage. Similarly, Ian Bond of the Department of Aerospace Engineering at the University of Bristol in England works with minuscule glass tubes incorporated into various composites. "We cut ourselves, we bleed, and heal. It's the same kind of idea," Bond says. In World War II, the idea produced self-sealing fuel tanks on Allied aircraft; a rubber bladder lined the tanks and swelled shut when punctured. Today, tests have shown that some composites reclaim up to 90 percent of their strength.

Self-healing materials are not yet flying. Easier detection of cracks in composites will come first—Boeing's 787, for example, will be half carbon fiber reinforced plastic and other composites by weight, most of it in the fuselage and wings. Detecting damage takes time and effort, usually involving ultrasound equipment. One proposed damage-revealing material would use liquid within embedded vessels, Bond says; the liquid might enable "self-healing, or it could just be some kind of bruise" that highlights an area of damage.

Nikhil Koratkar, a professor at Rensselaer Polytechnic Institute in Troy, New York, has developed a composite embedded with electrically conductive carbon nanotubes blended with a heat-activated healing agent. He sends electricity across the structure, and when the current travels around a crack, its resistance increases. This heats the composite and the crack, which melts the healing agent, which then flows into the crack and returns the structure to 70 percent of its original strength.

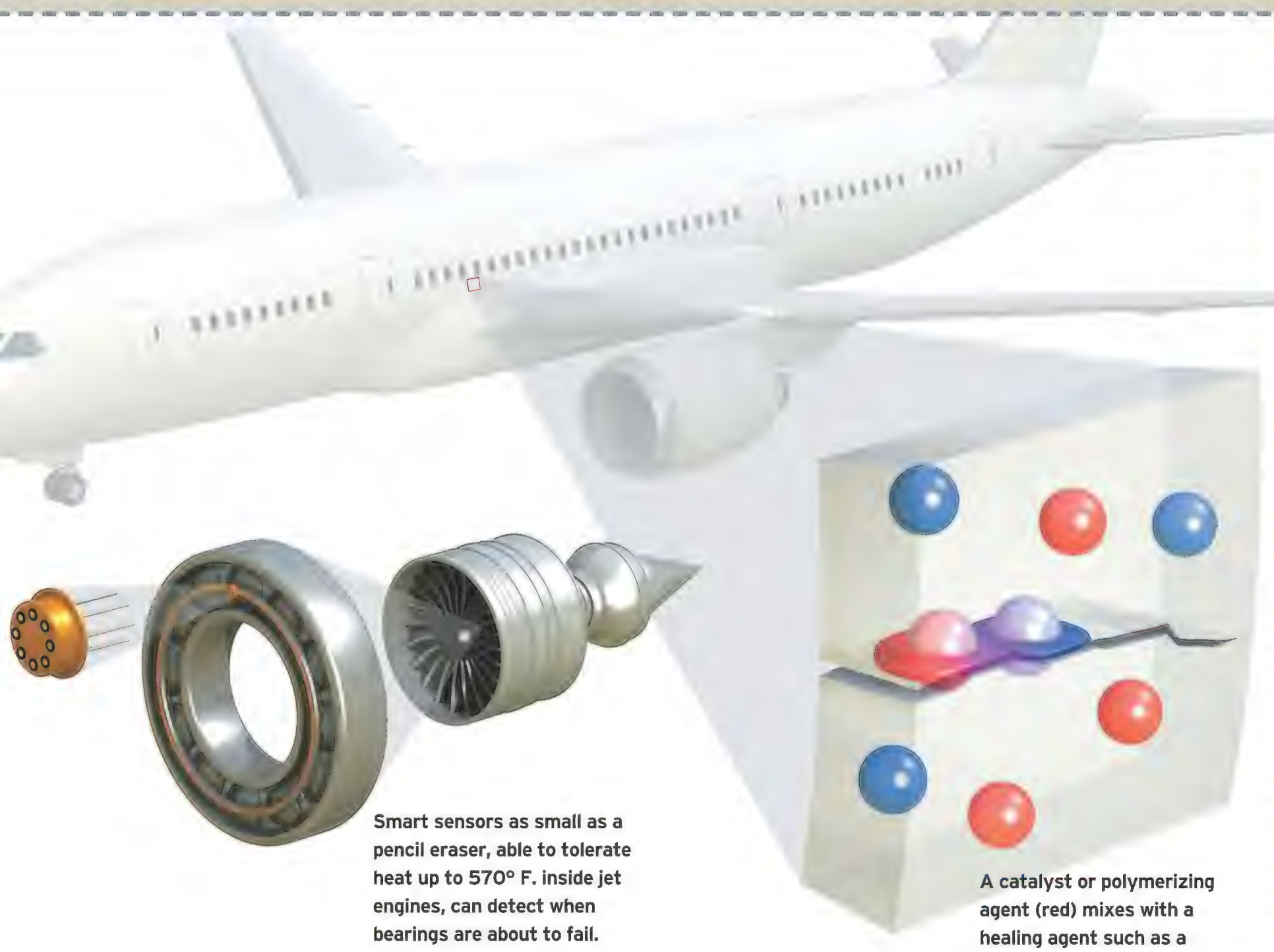
Self-healing aircraft may be the long-term aim of the research, but they're high-risk, with a long and involved qualification process. For now, researchers are looking at non-aviation uses. Bond is considering windmills. "They're wings, after all," he says.

Exposed wires may one day be fixable in flight. The Federal Aviation Administration has been sponsoring Bob Kauffman, a research chemist at the University of Dayton Research Institute, to develop the application of a water-soluble substance that becomes an insoluble polymer coating when

B. BLAISZIK, UNIVERSITY OF ILLINOIS

Broken microcapsules leave impressions seen through a microscope after a healing agent has bled out in a fracture plane of a composite material.

ng Airplanes



Smart sensors as small as a pencil eraser, able to tolerate heat up to 570° F. inside jet engines, can detect when bearings are about to fail.

A catalyst or polymerizing agent (red) mixes with a healing agent such as a monomer (blue) to seal cracks.

it contacts a live wire. The substance can be sprayed directly onto a wire bundle, or embedded between the wire and its rubber coating during manufacturing. The wire then seals itself when exposed to, say, the moisture from condensation an airliner gathers as it descends.

A self-healing airplane, says Byron Pipes, professor of engineering at Purdue University, is "infatuating to people because it would require no intervention." Self-healing, he adds, is the logical result of intelligent sensing and prognostics.

Purdue researcher Dimitrios Peroulis is working with the U.S. Air Force to develop sensors able to monitor bearing viability in jet engines. His colleague Doug Adams says that the information will allow mechanics to swap out a bearing that's about to fail and leave others to complete their life cycles. Current protocols require throwing away good parts according to a maintenance schedule. If they're self-monitoring, says Adams, "while the individual parts will be more expensive, you'll save money, as you'll replace them less often. It also means the machines will be in service longer between maintenance checks."

Composite materials have already made the 787 about 20 percent lighter than if it were made with the amount of aluminum found in previous jetliners. Future ones will be lighter still, more efficient, cheaper to maintain, and profitable for longer periods. If you combine these advances with self-healing, Pipes says, "now, *that's* the dream." Just not the dream of a mechanic in need of steady work.

The Airport That

HOW A FLORIDA COMMUNITY CAMPAIGNED FOR HISTORY.

FROM A LONG FINAL for Runway 6-24, Albert Whitted Airport looks like an aircraft carrier on the glittering blue of Tampa Bay, neatly berthed alongside the modest skyline of St. Petersburg, Florida. The field is groomed like a fairway, its aprons and tie-down areas dotted with light aircraft that, while mostly middle-aged, seem freshly minted.

For some visitors, the tableau will evoke flying in the 1970s. Older hands may picture Betty Grable debarking from a Lockheed L-10 Electra. Why? Because this is what all city airports were once like: small, tidy, fairly busy, and, most important, downtown. Whitted is one of the last of its kind, a relic of a friendlier epoch of aviation.

The best view of the field is from Randy York's Schweizer 300C helicopter. A compact, cheerful man, York has spent much of his life flying rotary craft, including two tours in Vietnam as a gunship pilot. Buzzing with him around St. Petersburg's high-rises, you see how the airport and city blend seamlessly. The airport's east-west runway flows into First Street South only a few blocks from the heart of town.

Wouldn't Die

BY CARL POSEY | PHOTOGRAPHS BY MIKE RAMOS

When you mention the apparent blurring of boundaries, York dusts off the mother of all airport accessibility stories. An elderly couple, lost after leaving Tampa International, finally reached what they thought was the interstate. But the "freeway" turned out to be a runway, 18-36. Apparently undaunted, they drove their rental car off the end of the pavement and into the bay, where, luckily, police were staging maritime rescue drills.

Just outside the northwest corner of the airport sits one of the city's water treatment plants, which, when the wind is right, makes its presence known. Next to that is a Coast Guard station, and nearby, a garishly decorated floating casino called Big Easy idles.

The airport's 110 acres may be the most valuable property in St. Petersburg, the kind of waterside property that makes developers salivate. Land like this, they say, deserves better. But others think the land was meant to be an airport, a place where citizens can hang out and watch the airplanes, largely unimpeded. It's not just an airport, they'll tell you, it's *our* airport.

THE FIELD HAS BEEN a target almost from birth. In 1935, just as the airport's operations were starting to grow, a local investment company wanted to turn the site into wharves. As early as 1940, the powerful *St. Petersburg Times* began a long campaign to get rid of the airport. In 1958, the city manager tried to close the field and allow development; a local pilots' association coalesced to defeat his plan.

In 1982, a city council committee proposed peeling off some airport property for a convention center, and giving the remaining land to the nearby University of South Florida. The full council, however, backed the airport. During the dispute, defenders of the airport asked the mayor to form an advisory committee. The mayor demurred, urging instead the creation of a private committee that the city government could not load with its pals. The result was a 12-member firewall between the airport and city politics—a key factor in future battles.

All these were mere skirmishes compared to what was coming. A year after the 2001 municipal election, St. Petersburg's economic development director, Ron Barton, floated a plan that would close the airport altogether, devote about

Albert Whitted Airport in St. Petersburg remains a developer's dream. Top: Whitted (third from left) poses with swimmers on his seaplane. In the 1930s, National Airlines flew Stinson Trimotors (middle and below, with two employees) from the airport.

ARCHIVAL IMAGES: ALBERT WHITTED AIRPORT PRESERVATION SOCIETY HISTORIC COLLECTION

60 acres to a bay-front park, and use the other 50 for an "urban, mixed-use community." The city council rejected the idea, inflaming its proponents, who quickly banded to form the Citizens for a New Waterfront Park.

In St. Petersburg, any change in the way waterside property is used requires an amendment to the city charter, via a referendum vote. To get the issue on the ballot, proponents must submit a petition signed by at least 10 percent of the voters from the last municipal election. By August 2003, the Citizens for a New Waterfront Park had the necessary 15,000 signatures and a secure place on the November ballot.

"It looked like they would win," recalls Jack Tunstill, a longtime flight instructor who became one of the generals in the airport war. Now, against what seemed long odds, the airport side fired back. Almost overnight, yellow-and-black signs calling for citizens to support Whitted bloomed like fields of daffodils across Pinellas County. Randy York put a big one in the bed of his pickup and drove it around St. Petersburg. The Advertising Air Force, a company that flies banner advertisements, towed "Save Albert Whitted" signs from its airplanes for free. Money flowed in from the Aircraft Owners and Pilots Association, which established a political action committee and paid for a consultant.

A potent community outreach effort got under way. Terri Griner, a petite kindergarten teacher who has a longtime involvement in local politics and a soft spot for aviation, became its mainspring. "We were very upset," she says. "We asked people to join. We did the name [the Albert Whitted Airport Preservation Society], the logo, and everything right there on that dining room table. We began with three board members. Now it's up to about 2,000 folks. Everybody in the community helped. We had a big meeting in the Marine Science Building and 300 people showed up. It was awesome." Then they arranged a 75th anniversary airshow in October that wowed everybody, and earned money for the cause.

Kindergarten teacher Terri Griner, president of the Albert Whitted Airport Preservation Society, led the fight to save the airport. Her group now hopes to raise $550,000 to build a multi-purpose community center and air museum there. Below: The new terminal opened in 2007.

Bud Risser, who is on the airport advisory committee and owns a Piper Malibu Mirage and co-owns an Eclipse 500 light jet, recalls some of the council meetings: "One of the people there was a good-looking young black guy. He said, 'I used to ride my bike to the airport to watch the planes. I'm now an airline captain.' A woman said, 'I've never flown in a plane, but I've taken my children, my grandchildren, and I will take my greats, to the airport.' "

St. Petersburg became bitterly divided. The airport backers dismissed their opponents as shills for developers. The park people said they were offering a better use of valuable land and that the talk about high-rises was bunk.

The University of South Florida, already bursting at the seams with students, wanted the east-west runway closed so the school could build taller buildings. So did Bayfront Medical Center, All Children's Hospital, and the Poynter Institute, which is owned by the *St. Petersburg Times*. But any changes in how the property was used needed approval by both the Florida Department of Transportation and the Federal Aviation Administration, which effectively owns the runways. Anything done to extend a

In 2003, Steve Lange (left) chaired a sign-waving group that met each Friday at a different intersection in the city.

MIDDLE: RICHARD LESNIAK; LEFT: DIRK SHADD/ST. PETERSBURG TIMES

With the beaches of St. Petersburg below him, Rick Cureton takes his 1940 Boeing PT-17 Stearman for a cruise. He's the third owner since it was used as an Army trainer.

runway into the bay would bring in the Army Corps of Engineers, as well as state and federal environmental agencies.

James Bennett, chair of the St. Petersburg city council and also a pilot, contacted the FAA, which, he says, "had stopped funding [the airport]. It was in disrepair. When you take money from the federal government, you're tied in for 20 years. The city had received tons of money from the FAA over the years," so if the airport were reduced or closed, "we would have [had] to pay that money back."

Mayor Rick Baker offered an alternative: Leave the airport with a single north-south runway, 18-36, extend it a few hundred feet into the bay, and sell off about 30 acres for development. A few pilots went along. "The idea was, they're going to close the airport and there's nothing we can do about it," Tunstill recalls. But while the mayor's idea served nearby property owners, it did nothing for the two main combatants. The park people would get nothing, and the airport would lose its long runway. Absent any compromise, the conflict settled into a winner-take-all contest at the ballot box that fall.

Two ways to see the city: In Randy York's Schweizer 300C (above) or Tom Hurley's 1933 WACO UIC, once owned by newspaper magnate William Randolph Hearst. Hurley sells rides in the biplane, which lived for a time at Hearst's San Simeon, California estate.

The airport people had no trouble finding their 15,000 signatures. Then, around midnight, just minutes before the October 1 deadline to get the issue before the voters, the airport advisory committee and city council agreed on the wording of the referendum questions and moved the airport to the top of the ballot. The first question asked if the airport should be kept open "forever." The second, whether the city council should accept FAA grant money without consulting the airport's neighbors. And the third, whether the airport property should be turned into a park, or divided along the lines the mayor suggested.

Like many people involved

The Sad Tale of Chicago's Famous Little Airport

Tom Hurley's WACO is a flying advertisement. "This is my retirement," he says.

MERRILL C. MEIGS FIELD, named for the air-minded publisher of the *Chicago Herald-Examiner*, was not much more than a 3,900-foot north-south runway on Northerly Island, a narrow man-made peninsula jutting into Lake Michigan. The little downtown airport opened in December 1948 and quickly became one of those fields almost everybody likes.

Meigs was called the world's best-known single-runway airport – even by pilots who had never flown there. Because the inventors of what became Microsoft Flight Simulator were at the University of Illinois, Meigs served as the default home field for simulated flights.

"In late 1994, I heard they were thinking about closing Meigs," recalls Steve Whitney, owner of a Lake Buccaneer amphibian airplane and former president of the Friends of Meigs Field. "The 50-year lease let in 1946 expired in 1996. [Mayor Richard M.] Daley expressed interest in closing. We succeeded in getting a stop until 1997, then a five-year stay of execution."

Whitney says that Friends of Meigs went from a few enthusiasts to some 6,000 members worldwide, and received enormous help from the Aircraft Owners and Pilots Association and area Experimental Aircraft Association chapters. The National Business Aviation Association pitched in as well. "Informal polls, the Internet, were overwhelmingly for the field," Whitney says. "The formal polls [among Chicagoans] had a 60-40 favorable public vote."

In 2001, before the September 11 attacks, there was debate about whether to extend Chicago's O'Hare International Airport or build a big regional facility. The city opted for both, promising as part of the bargain to keep Meigs open for 24 more years. It looked as if the war was over and the airport had won.

It hadn't.

At about 1:30 a.m. on March 30, 2003, a squadron of bulldozers dispatched by the mayor's office gouged a series of Xs in Meigs' single runway, rendering it useless for air traffic and stranding 16 aircraft. (They later took off from a taxiway.) Daley claimed the act was intended to prevent terrorists from using the field to attack downtown Chicago. Nobody believed it.

The act itself was not illegal: Meigs was the city's to destroy. But wrecking the runway without giving a 30-day notice violated Federal Air Regulations, as did using Federal Aviation Administration grant money to pay for the bulldozers' nocturnal romp. The city was slapped with the maximum fine, $33,000, and agreed to repay $1 million in misused FAA funds. But Daley got what he wanted: Meigs was history.

Northerly Island is supposed to become a park and a venue for the 2016 Summer Olympics, should the games go to Chicago. "Just grass and stick trees there now," says Whitney. "But the new grass is different, so sometimes you can see where the concrete was."

Meigs may not have died in vain. In their 2003 campaign, the friends of Albert Whitted Airport chose not to use the Chicago experience as a negative example, but many believe that the March destruction of one famous little airport may have affected the outcome of St. Petersburg's referendum eight months later.

Meigs in happier days: The once-busy urban airport was put out of commission when bulldozers, ordered in by the mayor under cover of darkness, gouged giant Xs in its lone runway. So sudden was the destruction that not even the control tower knew.

in the dispute, Risser is old St. Petersburg. "In 1959, I got my ticket here," he says. "My dad flew out of here a decade or more before that." But his perspective is also that of a prominent businessman. "When they started this effort, I thought they were wrong. The 'forever' thing. I thought they were really naive in their approach. So I commissioned my own poll. It said they were going to win."

The *Times* differed. "One day," a late-October editorial intoned, "St. Petersburg residents will tire of being denied use of more than 100 acres of public land.... They will tire of Federal Aviation Administration control of such valuable property.... They will tire of a noisy airport that restricts the neighboring university and hospitals, and that presents a growing pubic-safety threat to downtown residents."

Strong stuff. But by the time the editorial appeared, the park forces, whose message had never quite jelled, had lost momentum. On November 4, 2003, in the biggest municipal voter turnout in 50 years, some 25,000 residents voted with the yellow signs: 72 percent wanted to keep the airport open, 67 percent favored the city's accepting federal aid, and 78 percent voted against turning the airport into a park.

Howard Troxler, a *Times* columnist, summed it up: "There never was a clearer election result. The sun was not in anybody's eyes.... It required 15,000 petition signatures just to get the park idea on the ballot; only 7,783 people actually showed up to vote for it." Through the fight, Troxler had kept a black-and-yellow pro-airport sign on his office wall.

Bud Risser notes that the voters were not just supporting aviation. Crucial reinforcements came from a "number of other constituencies that had nothing to do with flying," he says. "One group didn't want to see high-rise buildings near the waterfront. Another group, in west St. Petersburg, worried that too much emphasis was on downtown."

LEFT: THOMAS HERTER

A replica of a Benoist XIV, the airplane that inaugurated commercial aviation with a flight from St. Petersburg in 1914, hangs in the St. Petersburg Museum of History.

It was a resounding victory. "After the election, I looked at every precinct," Risser says. "The one we didn't carry, off the south end of the airport, was a 49-51 split. The demographics were everybody."

TO MANY RESIDENTS, a vote for the airport was also a vote for preserving important aviation history. Ninety-five years ago, on January 1, 1914, a Benoist XIV flying boat lifted off from the bay front before a cheering crowd and flew the 21 miles across the water to Tampa. It was the world's first scheduled airline flight. Young pioneer pilot Tony Jannus became the world's first commercial airline skipper and Mayor Abram C. Pheil the first scheduled-airline passenger. A flying replica of the Benoist, built for the 75th anniversary of the first flight, hangs in the St. Petersburg Museum of History not far from the airport.

James Albert Whitted became the local face of aviation. During World War I, he'd been one of the first pilots in the U.S. Navy, teaching at Pensacola and flying from the improvised carrier *Langley*. After the war, Albert began designing and building airplanes with his brother Clarence, a talented mechanic. Together, they built two pusher-type seaplanes, the Bluebird and the Falcon.

"My dad was a genius on any kind of engine," says Eric Whitted, a retired educator who has become keeper of the Whitted brothers legend. Then, as now, flying was great fun, but not necessarily a living. "Albert didn't have to work," his nephew explains. "My grandmother owned most of the real estate around Central Avenue."

In mid-August 1923, while Clarence was grounded with a broken arm, Albert took four passengers up in the Falcon on a flight to Pensacola. The prop threw a blade and the airplane crashed, killing all aboard. "My dad never fully recovered from Albert's death," says Whitted. In 1928, the city opened the airport that bears his name.

In 1929, the Goodyear blimp came to visit, and ended up staying. A huge hangar was raised. It looked like the beginning of a golden age. Unfortunately, the Great Depression was right behind it. By April 1930, all the banks in St. Petersburg had closed, and Goodyear retrieved its airship. All that remains of the blimp are two iron tie-down rings planted in concrete blocks.

Despite the hard times, the city built Hangar One in 1931. Three years later, a young

Whitted is still a moneymaker, says airport manager Richard Lesniak (right). In the 1940s, National Airlines was a big customer, flying Lodestars in and out; the company merged with Pan Am in 1980.

MIDDLE: ALBERT WHITTED AIRPORT PRESERVATION SOCIETY HISTORIC COLLECTION

Today unfurling a message for beachgoers, the Advertising Air Force rallied residents during the dispute, using Cessna L-19 Bird Dogs to tow "Save Albert Whitted" banners.

Chicagoan named Ted Baker (no relation to the current mayor) moved in with two used single-engine, four-passenger Ryan Broughams, a skeleton staff, and a government-awarded franchise for the 142-mile St. Petersburg-Daytona Beach mail run. Baker's outfit was the forerunner of what would become National Airlines, the nation's seventh largest carrier before it merged with Pan American.

The airport continues to draw visitors, many of whom stay. Henry Van Kesteren, known as Van, first visited Whitted in 1962, while ferrying his family in a Piper Apache from his Air Force assignment in Suriname to a new post at Travis Air Force Base in California. "We landed in Miami to clear Customs," he recalls, "so I said, 'Let's run up to St. Petersburg.' We stayed at a little hotel across the street. Borrowed a car and toured around. I thought, 'What a neat little town,' not knowing I would come back."

His last posting turned out to be MacDill Air Force Base, across the bay. When his military career ended in 1969, he and wife Ginny, also a pilot, settled into St. Petersburg and immersed themselves in Florida's real estate boom. Their business card advice: "Let us show you from the air."

When Bay Air Services, the airport's fixed base operation, came on the market in 1973, Van Kesteren purchased it with a partner, whom he bought out a year later. He ran Bay Air until 1987, owning and flying just about everything that flew. He was also active in developing supplemental type certificates, which the FAA issues for product modifications. "It's like a patent," he explains. His certificates have included composite props for the Piper Malibu and Aerostar. Today his company, VK, Inc., occupies a big blue hangar on the north side of the field, home to a polished Aerostar, a straight-tail Beechcraft Baron, and a blond labrador named Rusty. "I just deal in airplanes that interest me," says Van Kesteren, now a trim 88 with some 39,000 hours. His most recent acquisition is an Eclipse 500, which he owns with Bud Risser.

Ron Methot, a tall, rangy fellow, now runs Bay Air and St. Petersburg Flight Service. The time-honored tradition of washing and gassing and moving airplanes in exchange for flight time—extinct at many general aviation fields—is alive and well here. "We've got guys who were here pumping gas who [now] fly for airlines," Methot says, who pumped gas himself there at 17. "I am sometimes referred to as a drug dealer, flying being the drug." Today, he has logged about 25,000 hours. "I've always

Advertising Air Force pilots Tom Gibson (kneeling) and Kevin Wilson, who's also a co-owner, check the L-19's tow release.

As a boat speeds by in the distance, Dave Oliver (left) teaches a young would-be pilot the basics of flying in his RV-6, while Dave Thompson shows off his A-26 Vulcan. For youngsters, the airport's Albert Whitted Park has a playground.

flown off this airport, and I haven't flown what can't come in here."

That would include everything that needs more runway than the 2,864 feet of 18-36 and the 3,677 feet of 6-24. "Short runways mean we don't have the corporate traffic that takes over an airport," says Methot. "We have to rely on smaller aircraft users. We don't sell enough fuel to do this for a living. It got tougher after 9/11."

Randy York's office is in another corner of Hangar One. "I've been here since August 1978," he says. "I got my flight school approved in '78, set up at Bay Air. A few months later, Van and I partnered up in the helicopter business."

York bought the company in 1987 but continued to share Hangar One with Bay Air. "About six years ago, we had 20 helicopters from all over the world. I downsized." West Florida Helicopters now operates four piston-powered Schweizers in Hangar One. "We do photo flights. Rebuild them for resale."

An extension grafted onto the north side of Hangar One houses the cluttered upstairs office of airport manager Richard Lesniak, who came to Whitted after the 2003 referendum. He says revenues and rents earn the city $800,000 to $900,000 a year. Last year, the airport had 84,000 takeoffs and landings, with 185 airplanes and 300 jobs based there. "Since 2003," Lesniak says, "the city has put about $7 million capital in the airport, another $4 million for a new control tower and taxiway improvement—$11 million in five years."

Completed in 2007, the new terminal is named for John Galbraith, a former Marine pilot, and his wife Rosemary, a former flight attendant. Galbraith moved his investment firm to St. Petersburg because he could fly in and walk to his Bayfront Towers condo. Over the years, his philanthropic impulse pumped millions of dollars into a host of causes, including the airport.

When city playground money became available, Terri Griner, now president of the Albert Whitted Airport Preservation Society, put in a bid to create an aeronautics-theme playground by the control tower. The park, which seems to be always full of children, has a jungle gym modeled on the medevac helicopters that fly from the airport, swings with a blimp motif, and miniature airplanes on spring stands.

The Albert Whitted Airfest, Inc., an annual airshow, earned a small profit in 2006. But in 2007 it lost money, so last year's show was canceled. The next St. Petersburg Airfest is set for October 23 to 25.

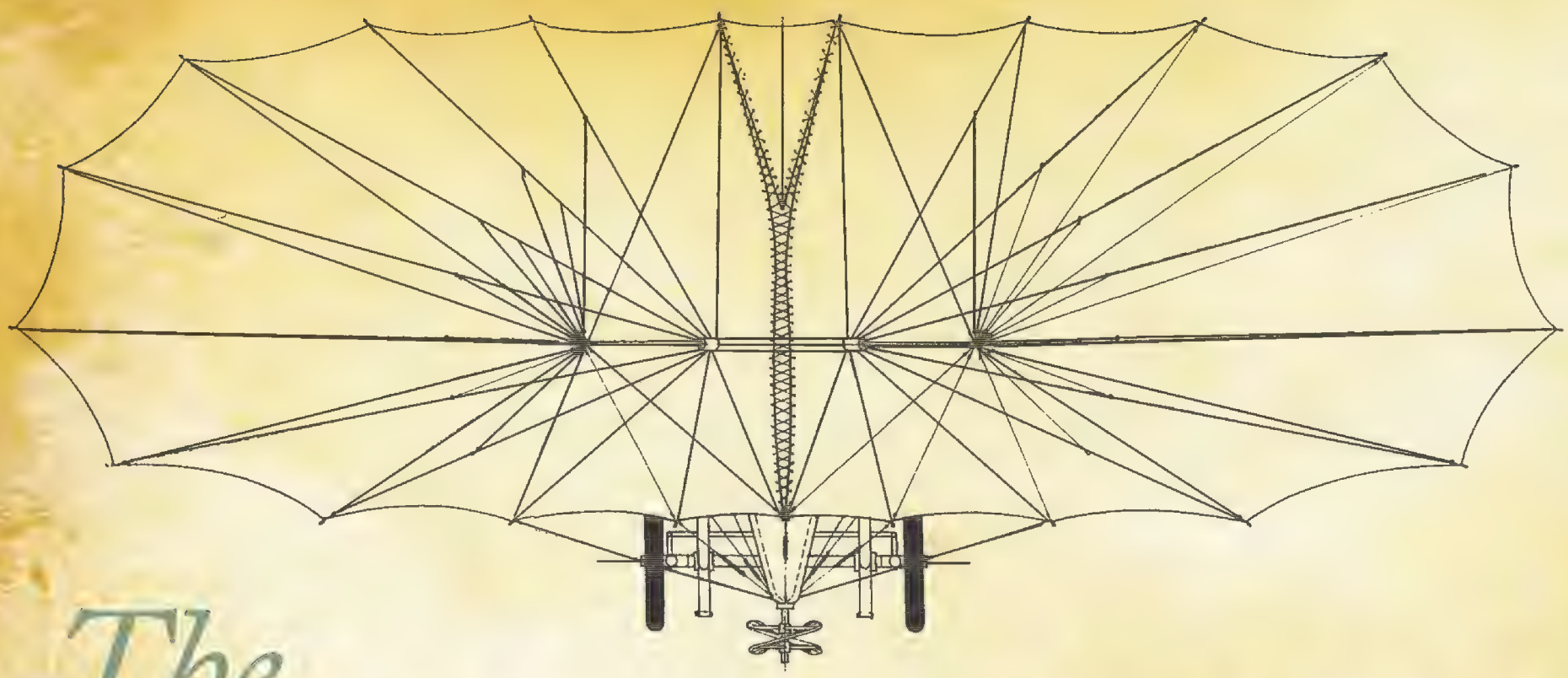
The preservation society has about 30 unpaid volunteers, including Griner, and a pool of perhaps 100 more for special projects. Pancake breakfasts are offered the first Saturday of every month, in tents set up outside the group's headquarters. "We market the airport," Griner explains. "We hand out welcome bags in the terminal, with city maps and so forth. We provide all the tours." They also got Hangar One named an historic landmark, putting another obstacle in the way of those who would try to close the airport.

The most interesting airplane at Albert Whitted may be the red WACO UIC biplane in Tom Hurley's hangar. This is his second WACO; its predecessor was an open-cockpit UPF-7. The UIC's enclosed cabin attracts people who want to fly in an old biplane, but don't want to be blown around.

Hurley is a big, sometimes gruff man whose hands are scarred and stained from the labor of keeping NC13562 flying. Today, he is putting it back together after the annual inspection. Hurley takes people out for hops of various magnitudes, flying low enough for passengers to get biplane experience and for people on the ground to read the big "BIPLANE RIDES" painted on the lower wing's underside.

Keeping an airport like Albert Whitted alive is not unlike caring for a 75-year-old biplane. History suggests that for downtown airports, "forever" may really mean "for now."

"The 2003 referendum was very convincing," says Methot. "We're accepting federal funds, which obligates us for 20 years. But I don't think any airport is safe in this country. All it would take to close the airport would be a new referendum."



The BIRTHPLACES *of Aviation*

IN THE FIRST DECADE OF FLIGHT, INVENTORS AROUND THE WORLD GOT INTO THE ACT (IF NOT INTO THE AIR).

BY ROGER A. MOLA

IN THE STORY OF THE AIRPLANE'S INVENTION, there are more characters than just the Wright brothers. And more settings too: In the first decade after the Wrights' landmark 1903 flight, airplanes were being invented in countries far beyond America and the other two hotspots of early aviation: France and England.

Many of the aircraft included here were the first to fly in their countries. Though big news locally, word of their success traveled very slowly. The 1912 edition of Jane's *All the World's Aircraft* says, regarding Chile's efforts in aviation, "There are vague rumors of machines building in Chili [*sic*], but so far as can be discovered, none have got beyond the model stage." Though that was technically true, a Chilean named José Luis Sanchez-Besa, living in France, was building both land- and seaplanes.

Many of the aircraft builders in this story clearly got ideas from fellow inventors; a few of these designs are close duplicates of successful forebears. But other inventors appear to have worked in isolation, largely unaware of other airplanes springing to life around the world. Besides the Wrights' crisp, sensible designs, the world began seeing airplanes with more exotic or eccentric appearances—and some could even fly.

BUJOR RAZVAN/WORLD WAR ONE AERO

CARROLL GRAY/WORLD WAR ONE AERO

UNESCO named 2006 the International Year of Trajan Vuia (above), honoring the Romanian's first flight, 90 years earlier.

NASM (SI NEG. #1B00437)

Hans Grade's monoplane in 1910. It's easy to see why the designer named it after the dragonfly.

NASM (SI NEG. #2001-6607)

The *Dufaux 4*, here in Geneva, Switzerland, in 1909, flew across Lake Geneva, doubling Louis Blériot's cross-English Channel flight distance.

1906 Romania: First flight

Romania

Though Trajan Vuia earned a doctorate in law in 1901, between scholastic assignments he sketched airplane designs. He moved to Paris to join what he considered the hub of the aviation community, and in February 1903 he offered a design to the Committee of Aeronautics of the Science Academy. The committee, adhering to the prevailing wisdom that the best design would be a double-prop biplane, rejected his single-propeller monoplane as a dream.

Still, that August, Vuia licensed his airframe design in France, and the next year licensed another design incorporating his 20-horsepower engine in Great Britain. He completed the full machine by December 1905.

That month, outside Paris and beyond the view of journalists, Vuia began maneuvering the body of his vehicle as a car; later he added wings and practiced faster taxiing.

While the first officially observed airplane flight in Europe was made by Brazilian Alberto Santos Dumont in Paris on October 23, 1906, according to some reports, on March 18 of that year, Vuia rolled the *Trajan Vuia 1* for 150 feet, lifted three feet above the dirt, and flew for 36 feet. Then his engine quit. Vuia is reported to have flown again in June, July, and August.

1908 Germany: *Libelle*

Germany

Like the Wright brothers, Hans Grade was schooled in the mechanics of two-wheel vehicles. He built his first motorcycle in 1903, and in 1905 founded a shop in Magdeburg, Germany, where he tinkered simultaneously with aircraft design and motorcycles.

By 1907 he had finalized a concept for a triplane. On October 28, 1908, his aircraft flew 24 feet. The following August, his monoplane, named *Libelle* (dragonfly) and based on Santos Dumont's *Demoiselle*—began hops from Borkheide.

In October 1909, Grade won 40,000 marks in a competition seeking the first German airplane with a German engine to complete a figure eight of three kilometers. Within a month, he could fly *Libelle* nonstop for 55 minutes, seated in chariot position and warping the wings by grasping overhead wires.

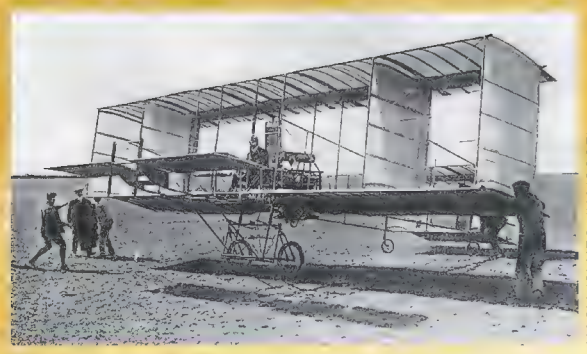
1909 Switzerland: *Dufaux 4*

Switzerland

Defying the overall storyline of aviation history, Armand and Henri Dufaux first gained fame as helicopter designers, delivering partially working models and running engine demonstrations as early as May 1905. Only then did they turn to fixed-wing design. The brothers' first prototype, the *Dufaux 1*, was shown off in Geneva and Paris, and led to a series of designs culminating in a 1908 triplane, which was to function as a tilt-rotor, with an engine that could pivot to provide either vertical or horizontal thrust. Brilliantly advanced, it never left the ground.

SWISS MUSEUM OF TRANSPORT

Like the Wrights, the Dufaux brothers Armand and Henri were fans of bicycling. Here, they enjoy the mountain air around Lac Leman, Switzerland, where they also tested their tilt-rotor technology.



NASM (SI NEG. #1A18885)

FERGUSON FAMILY MUSEUM, FRESHWATER, ISLE OF WIGHT

The boxy biplane of Belgium's Pierre de Caters in 1909 (above). Still on the ground in Ireland, Harry Ferguson's monoplane looks like it's already having lateral control issues (right).

1909 Belgium: Farman knockoff

Ireland: New Year's Eve first flight

1910 Hungary: The *Strucc* (Ostrich)

Belgium

Taking great liberties in designing his biplane in 1909, Baron Pierre de Caters studied the type III airplane of French designer Henri Farman and copied nearly every pulley and screw.

The following year, de Caters devised a sturdier monoplane with a front-mounted, 100-horsepower Argus engine and a 45-foot wingspan. The aircraft required quite a bit of muscle to fly. The baron grunted through turns he executed via wing warp pulleys anchored to the wheel struts, and a rudder bar responded to stomps of his foot.

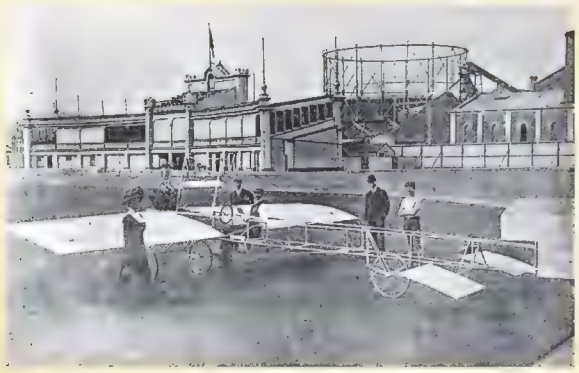
Ireland

In another example of aero-appropriation, Harry George Ferguson and Joe, his brother and partner in an automotive garage, would visit air exhibitions in France and England and take careful measurements of the parked aircraft. Throughout 1909 Harry fashioned his own airplane with 26-foot wings, pairing it with an air-cooled 35-hp engine by J.A. Prestwich. At Hillsborough Park in Belfast on New Year's Eve 1909, Ferguson's 32-foot monoplane achieved a maximum altitude of 12 feet; it stayed aloft for some 400 feet. The *Belfast Telegraph* reported: "The roar of the eight cylinders was like the sound of a Gatling gun in action. The machine was set against the wind, [and] the splendid pull of the new propeller swept the big aeroplane along as Mr. Ferguson advanced the lever.... Although fierce gusts of wind made the machine wobble a little, twice the navigator steadied her by bringing her head to wind, the first successful initial flight that has ever been attempted upon an aeroplane." Well, the first in Ireland, anyway.

Hungary

Two of the world's earliest journals devoted exclusively to aviation, *Aero News* and the professional journal *Aeronaut*, served as inspiration for young readers and would-be designers Janos Adorjan and F. Dedics. The two jointly designed a 25-hp, two-cylinder engine, which was built by the Köhler Brothers factory to power an elegant design named the *Strucc* (Ostrich). At 617 pounds, the *Strucc* had a wingspan of 26 feet, three inches, and was 24 feet long. In the Second International Air Race, held in June 1910, Adorjan became the first Hungarian to fly in his country in his own design. There were 29 competitors; the *Strucc* came in third.

It's September 1910 in Dunedin, New Zealand, and Herbert John Pither is at the controls of his monoplane. The question is: Did he ever fly it?



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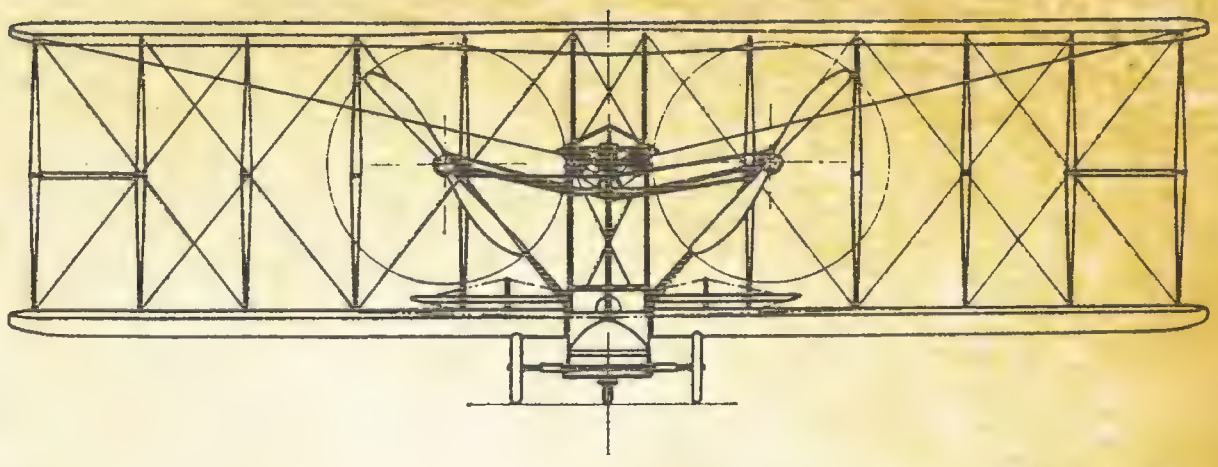


It looked good on paper, but Stefan Kozlowski's 1910 biplane performed erratically.

KRAKOW AVIATION MUSEUM

Poland: Kozlowski biplane

Canada: Gibson Twinplane

New Zealand: Monoplane

Poland: *Aquila* (Falcon)

New Zealand

Who made the first flight in New Zealand? Herbert J. Pither swore to journalists that he did, on July 5, 1910, at remote Oreti Beach, with no witnesses present. Yet Rosemarie Smith, who spent years researching Pither for the Croydon Aviation Heritage Trust, said Pither never repeated his original statement, and late in life—by which time the legend had grown to include multiple flights at lofty heights—he denied it altogether.

We do know that Pither was a bicycle-frame maker with a shop specializing in boat engines, so he had expertise in both framing and propulsion to use in constructing an airplane. He produced a variant of a design by Frenchman Louis Blériot, making a frame of steel tube and wooden ribs and covering it with fabric. The pilot would control yaw with a tail rudder connected to a foot pedal, achieve lateral stability by warping the trailing edges of the wings with a steering wheel, and control the craft vertically by raising or lowering the elevator with a lever. Pither fitted bicycle wheels with shock absorbers to the undercarriage, and powered the craft with a four-cylinder, 40-hp engine.

Whether Pither actually flew or not, says Smith, after 1910 he never again designed an aircraft.

Poland

Flying called to Stefan Kozlowski, who left auto mechanics in 1909 to enroll in a German flight school. After earning his pilot's certificate, he designed his own machine, a biplane with dual powerplants in a tractor configuration. The wings were inspired by the rectangular, rounded-tip wing structure of a Blériot XI.

Advised by a Czech engineer named Skopik, Kozlowski bought parts from France and Germany to assemble in a Warsaw lumberyard. His biplane was powered by a six-cylinder, 60-hp Anzani engine. During flight tests Kozlowski snapped the chain drives for the two tractor airscrews, so he replaced them with ropes leading from the engine shaft and then crossing, in the style of Wright biplanes, to counter-rotate the wood props. Kozlowski discovered that the Blériot-style wing struts were not rigid enough to cut vibration, so he replaced the pine with ash, and adjusted the position of the engine.

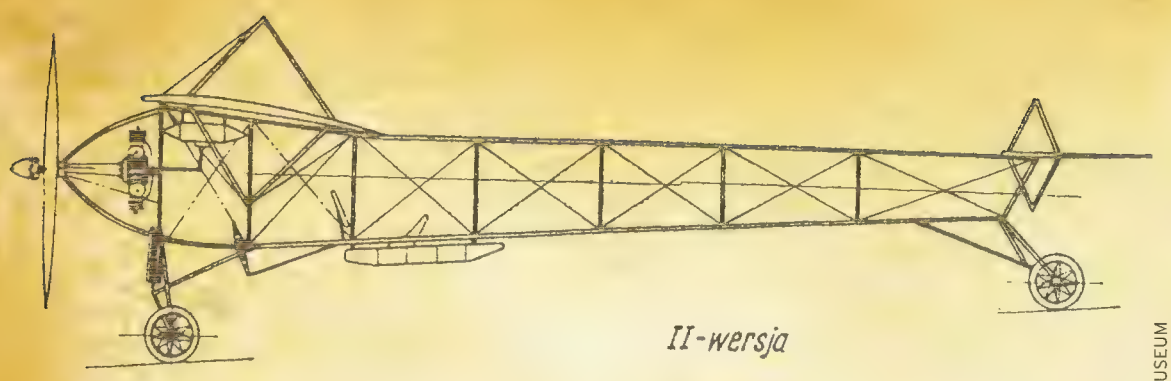
His design was spare and elegant, with no vertical stabilizer but with elevons on the wing, which could tilt one at a time for directional control normally provided by the tail. Maneuvered in opposite directions from each other, the elevons acted as ailerons for banking. When moved up to 60 degrees in concert, they functioned as air brakes.

In June 1910, Kozlowski made six flights: He never rose more than 10 feet, but he got up to 100 feet in distance.

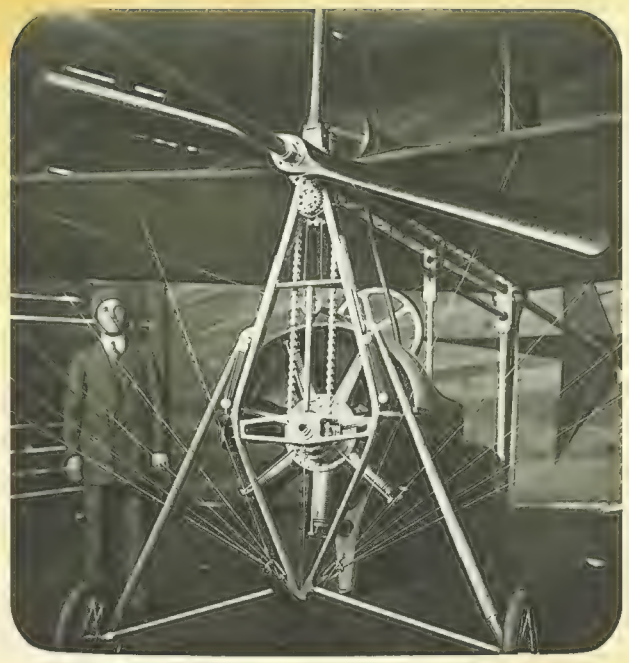
Finding the machine tail-heavy, he planned to add vertical and horizontal stabilizers. But in a flight test, the wing hit a dirt mound, leaving Kozlowski with minor cuts and bruises and his machine a wreck. His investors refused to pay for repairs, and by the autumn of 1910 they had stripped his machine of all salable parts. Understandably, Kozlowski retired from airplane building.

Another Pole, Henryk Brzeski, an engineer working in Vienna, devised an ingenious rotary engine; at the same time, in Krakow, Poland, the Schindler brothers—Wincenty, a mechanic, and Rudolf, an entrepreneurial inventor—built a scale model for a three-seat, high-wing monoplane, the *Aquila* (Falcon). In October 1909 they sent it into flight.

Bolstered by the small-scale success, the brothers tried a full-size machine, comparable to the Kozlowski design in that it lacked vertical tail surfaces, and the Schindlers teamed with Brzeski to begin work in Vienna. The *Aquila*'s triangle-shaped bamboo frame had been braced



KRAKOW AVIATION MUSEUM



NASM (SI NEG. #93-4228)

Team Romania: Above, Henryk Brzeski's *Aquila*; below, one of Trajan Vuia's comical but flyable contraptions.

1911

Romania: *Vlaicu 1*

Romania: *Vlaicu 2*

Romania

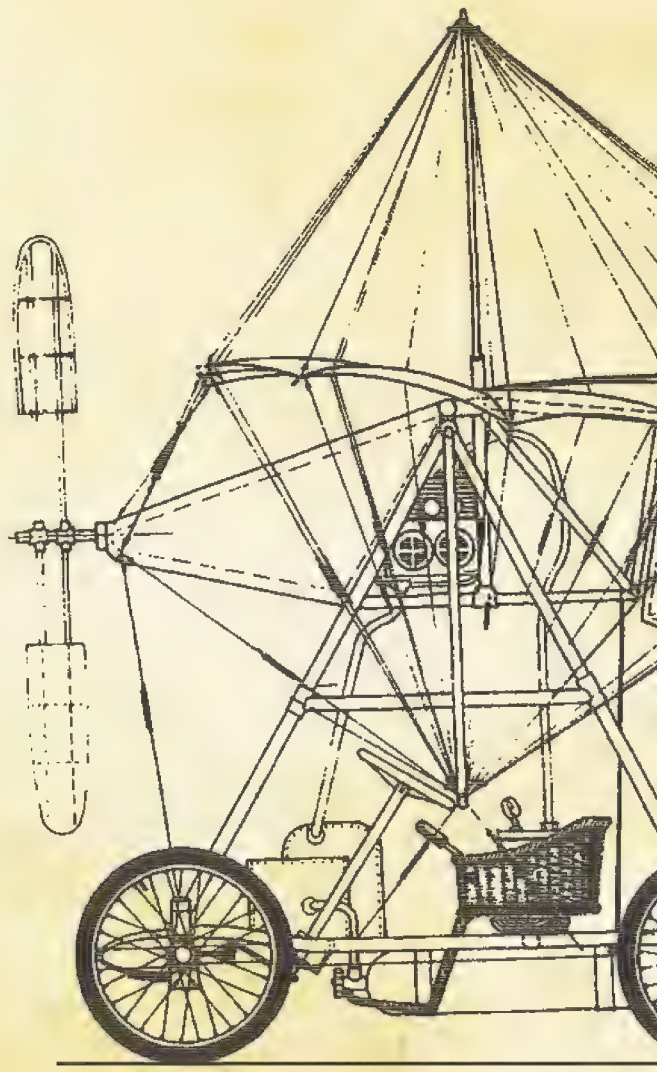
Born in the province of Transylvania, Aurel Vlaicu built a flyable glider model at Munich Polytechnic in 1907. Two years later, he built a glider in which he carried one of the first females to fly: his eight-year-old sister, Valeria. After an exhibit of Vlaicu's scale models in Bucharest, the Romanian war minister funded a workshop and staff at the Army Arsenal for Vlaicu to continue his work.

Vlaicu traveled to the Paris workshop of fellow Romanian Trajan Vuia to buy a 50-hp Gnome engine. By June 1910 he had produced *Vlaicu 1*, taking flight from Romania's Cotroceni military airfield. Vlaicu called his design a "flying machine with an arrow-like fuselage." The aircraft had a diamond-shape cockpit that hung like a pendulum beneath the fir wing spars. It had a hinged front elevator and rudders that moved in tandem. There were propellers in both the front and rear, and a fixed rear horizontal tail with two vertical control surfaces straddling the central aluminum tube, an arrangement that ensured stability and smooth turns.

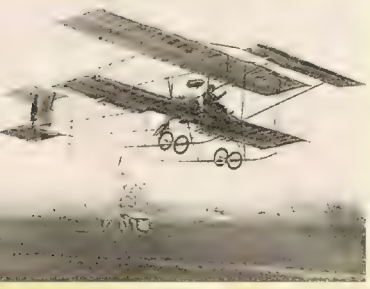
By mid-August 1910 Vlaicu could make sharp turns and exceed an altitude of 450 feet, and one of his flights surpassed nine miles. Within six weeks, in a test of army reconnaissance, he had risen above 1,500 feet, winning a prize from Romanian Prince Ferdinand that funded the launch of his *Vlaicu 2* the following February. This aircraft was a monoplane of a parasol design, with fabric on just the top of the wings and tail and without ribs—features that made the aircraft light and nimble.

by wire, and flight would be controlled by linking the wing- and tail-warping mechanisms to an inclined steering wheel. The aircraft would be powered by Brzeski's revolutionary 50-hp rotary powerplant, which he called *Iskra* (Spark).

In its first attempt, the *Aquila* shuddered aloft, and after 50 feet crashed into a hedge. The crash was blamed on the Schindler airframe, and the aircraft's development was scrapped.



Opposite: An unidentified man with a *Vlaicu*, probably No. 2. Below, José Luis Sanchez-Besa in his 1910 biplane.



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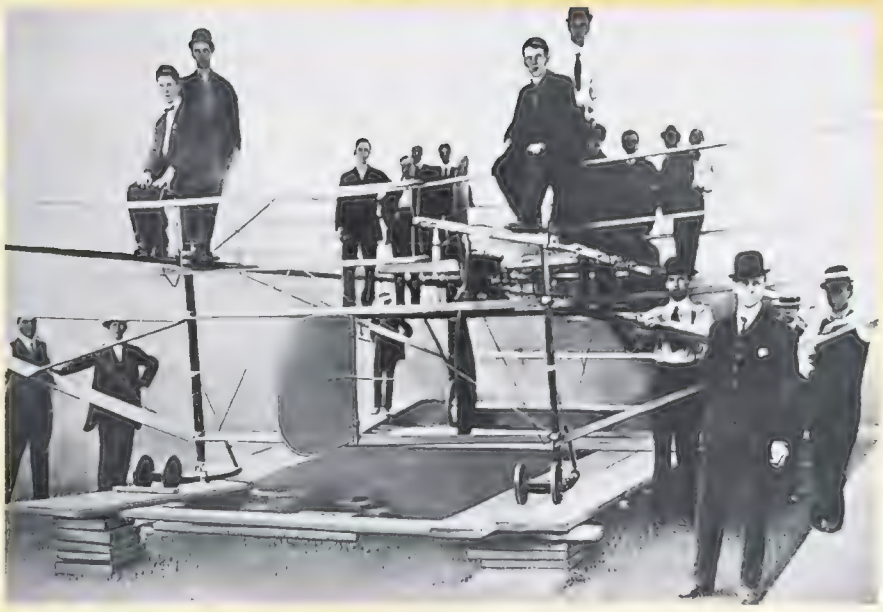


CANADA AVIATION MUSEUM

A multitude of men milling on the Multiplane (left). Frederick Koolhoven at the controls of the *Heidevogel* (below).

KOOLHOVEN AEROPLANES FOUNDATION

1912

Chile: Sea- and landplanes

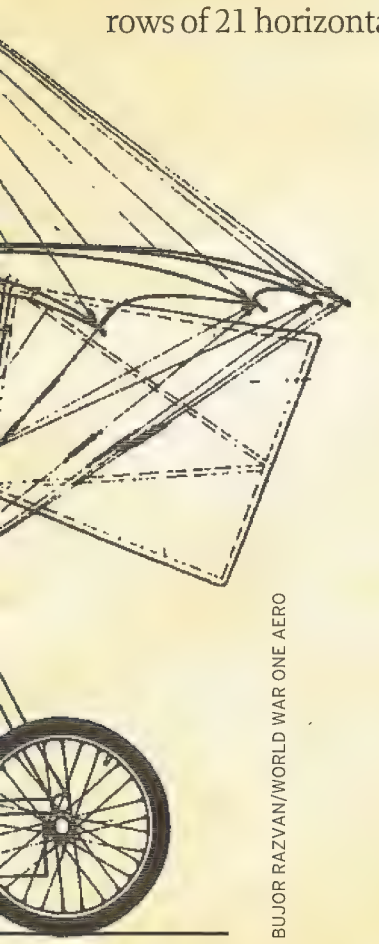
Canada: Gibson Multiplane

World: Airplane designs multiply.

Chile

Another designer who borrowed liberally from fellow aircraft designers, José Luis Sanchez-Besa copied the Wrights' pusher propulsion and the Voisin brothers' designs. His 1910 biplane was full of curves, with a front elevator and a 50-hp Anzani chain-drive engine linked to two pusher props. He created a number of successful aircraft, for both land- and sea-based operations.

His 1912-1913 seaplane wrapped the pilot in a virtual tub, yet a land-based version was aerodynamic enough to work. Perhaps his most ambitious design had a Venetian-blind-like configuration of airfoils: five rows of 21 horizontal surfaces each.



BUJOR RAZVAN/WORLD WAR ONE AERO

Canada

William Wallace Gibson made his money in mining, and in 1906 he began to invest in manufacturing engines. However, Gibson's propulsion efforts were marred. His four-cylinder engine shook itself to an early death. He had slightly better luck with a six-cylinder design, which in early 1910 yielded a smooth 60 hp. Next Gibson turned to an airframe. He sewed two 20-foot wings of silk staggered front and rear, and for pilot control used wires to tether a front elevator to his shoulder harness. On September 8, 1910, at a farm in Victoria, British Columbia, he managed to fly his 700-pound Twinplane 25 feet.

His second flight, on September 24, lasted 200 feet before a crosswind slammed him into an oak, crushing all but his engine and his spirit. By mid-1911 Gibson had fitted the same engine to a frame of four sprucewood wings, creating the Multiplane. This aircraft was now controlled by foot rudders. But in one of aviation's first examples of sponsor trouble, Gibson was grounded after a dispute with a promoter. In August 1911, Gibson's assistant flew nearly one mile in Calgary before crashing the aircraft to splinters, ending Gibson's interest in flight.

The Netherlands

In the autumn of 1910, Frederick ("Frits") Koolhoven, an engineer and race car driver, and Henri Wijnmalen, a former student of medicine, delivered what was hailed as the first all-Dutch aircraft: the *Heidevogel* (Heatherbird). A Dutch car dealer established a subsidiary to stage test flights by the pair (and, one assumes, draw potential car buyers). The *Heidevogel* turned out to be a near-exact copy of a Henri Farman biplane. The records on this airplane are scarce, but at least one photograph shows it flying.

Sightings

PICTURES WORTH A SECOND LOOK

NEW ZEALAND'S LIGHT paints with a glow that compels photographer Phil Makanna to leave his San Francisco home and cross the Pacific Ocean like a moth to a lamp. Combine that rich light with the work of The Vintage Aviator, a group of Kiwis who remanufacture World War I aircraft, and Makanna's been spending plenty of time in the air. Last March, leaning out of a Cessna 172, he used his Nikon D3 and a telephoto lens to capture this shot of a Royal Aircraft Factory F.E.2b with a Pfalz D.III in pursuit. The F.E.2b was a British World War I fighter with a precarious little basin for the gunner. "F.E." stands for "Farman Experimental," the company's designation for pusher props of that era. The D.III was a German fighter that served from late 1917 through the end of the war. This F.E.2b is fully rebuilt around an original engine that surfaced in Uruguay. "The engine is an outrage," Makanna says affectionately. "Copper-jacketed cylinders, water-cooled, truly 1915. Top speed was 70 miles an hour, and ripping top speed was, like, 71. In the 172, we had flaps down to the bottom. I had my legs out, trying to slow us down."

From the Passengers' Perspective

An exquisite new book documents how flying from coast to coast has changed – for better and worse.

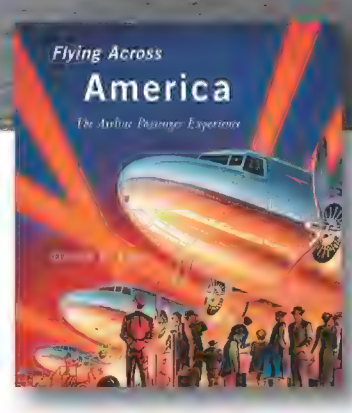
TWA ARCHIVES OF THE ST. LOUIS MERCANTILE LIBRARY AT THE UNIV. OF MISSOURI–ST LOUIS

A TWA DC-3 flies over New York Harbor in the late 1930s.

Flying Across America: The Airline Passenger Experience

by Daniel L. Rust. University of Oklahoma Press, 2009. 260 pp., $45.

IN 1926, MAUDE CAMPBELL paid Western Air Express $180—more than $2,000 in today's dollars—to sit on mail sacks in an open cockpit for a round-trip flight between Salt Lake City, Utah, and Los Angeles, California. Amenities were few: some cotton to protect the ears from the noise of the engine, a parachute in case of emergency, and a tin can for a toilet. (Campbell later told a reporter, "I waited until we got to Las Vegas [a refueling stop]. It was the only thing to do.")



Campbell was just one of 200 passengers to ride alongside the mail in a Douglas M-2 that year; in subsequent years, more and more people clamored for the adventure.

Daniel Rust's richly illustrated *Flying Across America* brilliantly captures the early passenger experience. Using firsthand accounts, Rust chronicles commercial air travel as it evolved from an expensive—and

TO ORDER THESE BOOKS FROM SMITHSONIAN SHOPS, CALL (202) 357-1387 OR -1388.

often physically demanding—adventure to today's commonplace event.

Rust packs the book with fascinating trivia, from innovative advertising campaigns (the Ford Motor Company sponsored aerial "ladies' lunches" to introduce upper-class women to airline travel) to efforts to entice young parents to fly (the airlines distributed free "baby kits" containing bibs, diapers, soap, tissue, and formula).

In today's era of crowded terminals, canceled flights, and cramped seats, airline passengers may wish to take a sentimental journey back to a time when air travel was an adventure—in a good way.

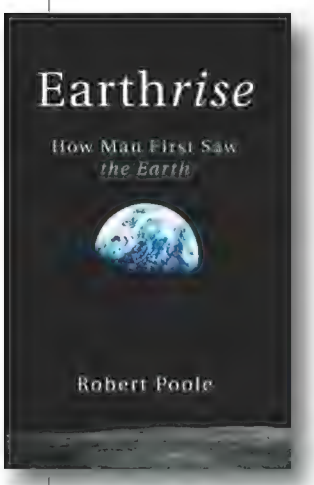
REBECCA MAKSEL IS AN ASSOCIATE EDITOR AT *AIR & SPACE/SMITHSONIAN*.

Earthrise: How Man First Saw the Earth

by Robert Poole. Yale University Press, 2008. 236 pp., $26.

AUTHOR ROBERT POOLE spends the beginning of *Earthrise* chronicling the attempts of 20th century science to photograph Earth from space.

His short history details the incremental advances made by attaching cameras to weather balloons, V-2 rockets, and low-orbit satellites. Poole says such progress culminated in 1968, when the crew of Apollo 8 snapped the famous "Earthrise" photograph, which showed the planet emerging from behind the moon (though he's also a big fan of Apollo 17's Blue Marble image, the first to capture Earth fully sunlit and in color).



Earthrise is more than a technological history, though. Poole argues that mankind's rush to explore the universe has made us more thoughtful. He connects a thick, green line between the wonder of those iconic Apollo images and the genesis of the environmental movement. As evidence, Poole offers up Earth Day (first held in 1970), the growth in popularity of the Spaceship Earth concept, and the spiritual awakening of several astronauts after they'd seen Earth from space.

At times, Poole's connections seem tenuous. That and an undercurrent of touchy-feeliness make *Earthrise* read as though he has struggled to knit a cozy sweater around a rather nebulous set of facts and notes. For a post-Space Race child like me, it seems unlikely that a couple of images I'd toss off as commonplace are responsible for CFC-free hairspray, the Kyoto Protocol, and the 2006 film *An Inconvenient Truth*. For earlier generations, however, the photographs were stirring and unprecedented. Earth was bluer, greener, and more peaceful than they had imagined, and there was magic in the way it floated in the emptiness.

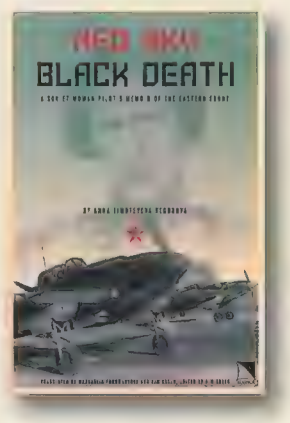
SAM GOLDBERG LIVES IN SEATTLE, WASHINGTON. A FORMER *AIR & SPACE* ASSOCIATE EDITOR, HE NOW WORKS AS A FREELANCE WRITER.

>>> Excerpt <<<

Red Sky, Black Death: A Soviet Woman Pilot's Memoir of the Eastern Front

by Anna Timofeyeva-Yegorova. Translated by Margarita Ponomaryova and Kim Green. Slavica, 2009. 213 pp., $29.95.

Anna Timofeyeva-Yegorova was a senior lieutenant in the Soviet air force during World War II. The following excerpt, from a chapter titled "Shot Down," tells what happened on August 20, 1944, as Yegorova, flying an Ilyushin Il-2 Shturmovik ground-attack aircraft, targeted German tanks near Warsaw.



My wingmen were in position on the right echelon. The gunfire intensified by the minute. If we made a direct approach, we'd find ourselves in an even denser wall of fire. If I turned left, my wingmen would find themselves under merciless fire as well. So I decided to veer to the right, making a gradual bank that I hoped wouldn't be noticed from the ground. The powerful curtain of fire moved away from us. But we were pushing further from the target, and the enemy guns would soon adjust their aim.

We turned back left and maneuvered through the artillery fire. It was time for the attack. I went into a dive. I couldn't see my wingmen, but I knew they were with me. We unleashed our guided missiles, cannons, and anti-tank bombs against the tanks. The ground beneath us erupted into flames. In the heat of battle, I forgot about the enemy's anti-aircraft guns. I didn't notice the rockets or the machine gun tracer bullets anymore.

Another attack, and another. Suddenly, my plane was shoved upward, as if someone had punched it from below. A second blow came, and then a third. The airplane became harder to control. It wasn't responding. I could no longer maneuver.

I tried with all my strength to force the Shturmovik into a dive and open fire. At first, I seemed to have succeeded. I led the group on another pass at the tanks, and my wingmen followed. Then they noticed I'd been hit. Someone shouted over the radio, "Try to make it to our side!"

The plane must be damaged, I thought...[it] wouldn't obey the control stick at all. I tried to open the canopy, but it was jammed shut. Smoke filled the cabin, choking me.

The blazing plane spun toward the earth, and I burned and tumbled with it.

[Yegorova was thrown from her aircraft, and her parachute did not fully open. After surviving a hard landing, she was captured and held in a Nazi concentration camp for five months.]

>>> Space: At a Glance <<<

A Dictionary of the Space Age

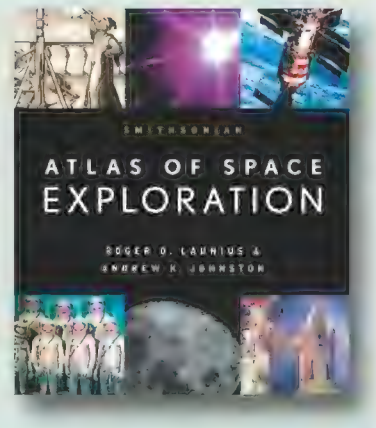
by Paul Dickson. Johns Hopkins University Press, 2009. 260 pp., $50.

Explaining such popular phrases as "faster, better, cheaper" and "spam in a can," this fun book is a must-have for space history buffs.

Smithsonian Atlas of Space Exploration

by Roger D. Launius and Andrew K. Johnston. HarperCollins, 2009. 230 pp., $34.99.

Launius, a curator of space history at the National Air and Space Museum, and Johnston, a geographer at the Museum's Center for Earth and Planetary Studies, have put together a history of space exploration from Ptolemy and Copernicus to the Mars missions of today.



The Saucer Fleet

by Jack Hagerty and Jon Rogers. Apogee Books, 2008. 328 pp., $59.95.

A well-researched history of the fictional flying saucers seen in such films and television shows as *The Day the Earth Stood Still*, *War of the Worlds*, *Forbidden Planet*, and "Lost in Space."

Almost Astronauts: 13 Women Who Dared to Dream

by Tanya Lee Stone. Candlewick Press, 2009. 133 pp., $20.

This book for young readers tells the story of women pilots who proved their mettle while taking astronaut fitness tests during the 1960s.

Secret Projects: Military Space Technology

by Bill Rose. Midland, 2008. 192 pp., $39.95.

The author examines the history of space technology developed for military purposes, looking at such programs as German rocketry during World War II and a proposed space-based chemical laser in the United States.

The Universe in a Mirror: The Saga of the Hubble Space Telescope and the Visionaries Who Built It

by Robert Zimmerman. Princeton University Press, 2008. 320 pp., $29.95.

THE HUBBLE SPACE TELESCOPE has been the most productive space science mission in history. The telescope has imaged planets around other stars and assayed their atmospheres. It has measured the age of the universe and proved that black holes live at the center of galaxies. And Hubble has confirmed that the universe's quickening expansion must be powered by a mysterious dark energy. A shuttle assignment to help service the telescope is one coveted by every astronaut: Only NASA's best spacewalkers are tagged to take on exacting repair work deep within the orbiting telescope's delicate interior.

The instrument was conceived more than 60 years ago; the people who transformed that dream to reality are the heroes in *The Universe in a Mirror*, Robert Zimmerman's readable, human-scale saga of the automated Hubble.

The space telescope survived a near-disastrous debut, nearly forgotten today. Budget and schedule pressures, combined with human carelessness, led to the launch of Hubble in 1990 with a subtle, undetected flaw: Its 94-inch main mirror was precisely ground and polished—into the wrong shape.

Yet astronomers ingeniously replaced one of Hubble's original instruments with a corrective optics package that compensated for the error. In late 1993, astronauts executed the most complex orbital repairs ever attempted, restoring the telescope to full capability. (The book gives Hubble's shuttle visitors only a cursory nod. The surnames of Gregory J. Harbaugh and

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Charles F. Bolden Jr.—the latter set to become NASA's new administrator—are misspelled.)

Altogether, five missions to the Hubble Space Telescope have replaced worn-out systems and modernized its instruments; the last mission was completed in May. Ably explaining the momentous discoveries produced by Hubble, Zimmerman helps us understand why today's astronauts accept heightened mission risk to extend Hubble's dazzling scientific output.

FORMER ASTRONAUT TOM JONES' LATEST BOOK, WRITTEN WITH ELLEN STOFAN, IS *PLANETOLOGY: UNLOCKING THE SECRETS OF THE SOLAR SYSTEM* (NATIONAL GEOGRAPHIC, 2008).

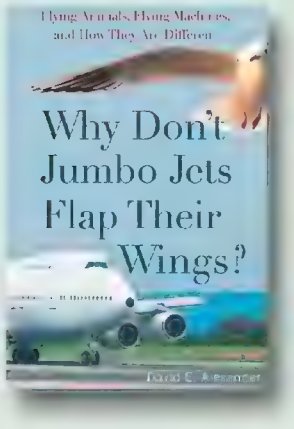
>>> Aviation: At a Glance <<<

Conquistadors of the Sky: A History of Aviation in Latin America

by Dan Hagedorn. University Press of Florida, 2008. 587 pp., $39.95.

This well-illustrated book chronicles the diverse achievements of Latin American aviators.

Why Don't Jumbo Jets Flap Their Wings?



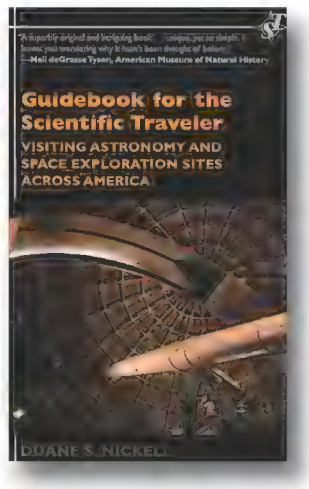
by David E. Alexander. Rutgers University Press, 2009. 265 pp., $26.95

An examination of how the study of flying animals can advance aeronautical science.

Guidebook for the Scientific Traveler: Visiting Astronomy and Space Exploration Sites Across America

by Duane S. Nickell. Rutgers University Press, 2008. 243 pp, $21.95.

ABOUT 20 YEARS AGO I lived in Princeton, New Jersey, for a month, but I never visited Albert Einstein's house there. Same with the Adler Planetarium & Astronomy Museum in Chicago: One weekend I was trapped in the city by a snowstorm, but I never made the short stroll from my hotel to see the place. And why haven't I been to the Kansas Cosmosphere in Hutchinson? Hell, I grew up in Kansas! I'll tell you why: I didn't know any of them was there. That's because there was no single tour guide catering to space geeks like me. Until now. Think of *Guidebook for the Scientific Traveler* as a no-nonsense guide to having a fun space-and-astronomy-themed vacation—a university textbook of travel guides, as it were. It even resembles my college Astronomy 101 textbook, but without the color illustrations and banal questions at each chapter's end.



Like a textbook, *Guidebook* is *verrry serrrious*. A chapter on aliens, UFOs, Roswell, and Area 51 could have added a note of whimsy, but the reader is warned in the introduction to expect "a highly skeptical point of view." Fret not, scientific tourist: Nickell assures us that Robert Goddard tested his early rockets near Roswell, New Mexico, and that there's an exhibit dedicated to him at the Roswell Museum and Art Center. That's reason enough to make the trip.

Guidebook is a bit dry sometimes, but Nickell, a high school physics teacher and an associate faculty member at Indiana University and Purdue University, does serve up easy-to-understand explanations of scientific principles. After 48 years and a college education, I now understand the Doppler effect. Sort of.

PHIL SCOTT IS THE AUTHOR OF SIX BOOKS, INCLUDING *THE SHOULDERS OF GIANTS: A HISTORY OF HUMAN FLIGHT TO 1919*. HIS MOST RECENT WORK, *HEMINGWAY'S HURRICANE*, IS AVAILABLE FROM McGRAW-HILL.

>>> Cool Stuff for Kids <<<

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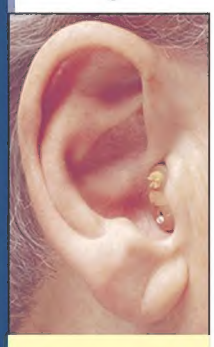

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Recovery: Bataan. The author of two books on search expeditions, Ralph Wetterhahn has appeared in numerous documentaries on aircraft archeology.

Brooders vs. Extroverts. Iraq war veteran Darisse Smith is an account executive with Alliance International, a firm that recruits junior military officers.

The Electric Airplane. Peter Garrison has flown across the Pacific in a homemade single-engine airplane, but he is afraid of electricity.

Into the Mushroom Cloud. Mark Wolverton's latest book is *A Life in Twilight: The Final Years of J. Robert Oppenheimer*.

Apache. Ed Macy has more than 3,900 hours flying helicopters, 645 of them in the Apache.

Secret Space Shuttles. Michael Cassutt is a novelist and television writer in Studio City, California.

From Pilot to President. Barrett Tillman specializes in naval aviation and has written 43 books. He's currently working on *Whirlwind*, the first single-volume account of all Allied air operations over Japan during World War II, due out in May 2010 from Simon & Schuster.

How Things Work: Self-Healing Airplanes. Tom LeCompte won a 2009 Aerospace Journalist of the Year award for his *Air & Space* article "The Disorient Express" (Aug./Sept. 2008).

The Airport That Wouldn't Die. Frequent contributor Carl Posey recently wrote features about F-105 Thunderchiefs and the Spanish Civil War.

The Birthplaces of Aviation. Roger A. Mola is an *Air & Space* researcher.

Forecast

IN THE WINGS AND ON THE WEB...

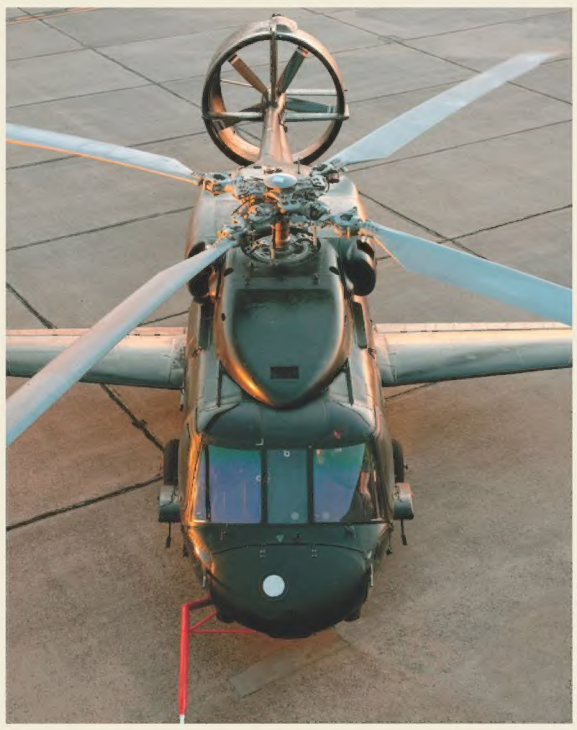
THE INVENTION ISSUE

Ejection seats, the all-moving tail, the stall warning device, and...escape poles? *Air & Space* takes a look at some of the great – and not-so-great – inventions of the aerospace industry. Which inventions transformed flight, and which were better left on the drawing board?

FEATURING:

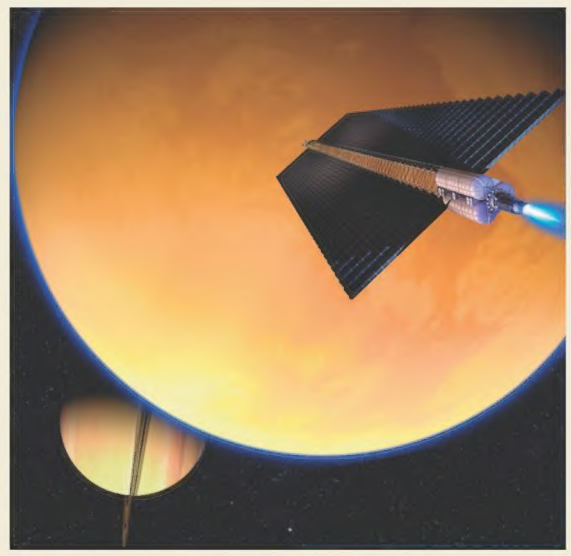
Out of Thin Air
Commercial air travel couldn't take off until cabins were pressurized.

Warp Speed Ahead >>>
What will it take to make interstellar travel a reality?



CHAD SLATTERY

Piasecki's vectored-thrust ducted propeller might just bring the Black Hawk and other rotorcraft into the fast lane.



PAUL DIMARE

In theory, a nuclear fusion rocket could travel at half a million miles an hour – reaching Jupiter in just 90 days.

<<< Fast Forward
The quest to break the rotor-wing speed limit.

The Impossible Airliner
What's keeping us from building an airplane that's fast, quiet, and green?

An issue devoted to inventions we can't imagine life without: brilliant solutions from the past, bright ideas for the future, and stuff we want invented now, dammit.

AT *WWW.AIRSPACEMAG.COM*

To mark the 40th anniversary of the first moon landing: Were you part of NASA's 400,000-person-strong effort to put a man on the moon? We'd like to hear from you. Visit our Web site to leave your story, and to read the tales already posted there.

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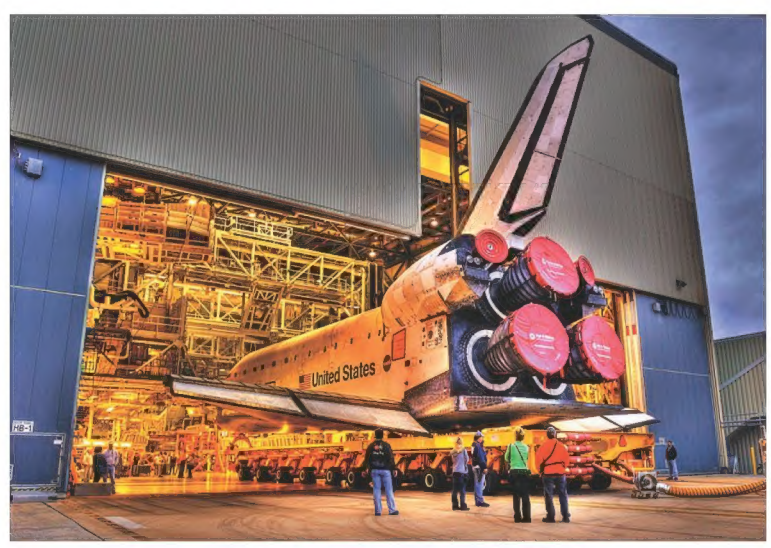

LARRY TANNER

Lights, camera, liftoff: *Endeavour* gets star treatment from photographer Larry Tanner.

Delivery Man

MAX CONRAD IS ONE OF aviation's indelible characters, and this year marks 30 years since his death at the age of 76. He was the father of 10 children, an accomplished musician, and a winner of the Harmon Trophy, but his mark in the aviation world was that of a manic long-distance record-setter: He once flew nonstop from Capetown, South Africa, to St. Petersburg, Florida, covering almost 7,900 miles in 58 hours. Most of his flying career was spent in the cockpit of light airplanes made by Piper Aircraft, and he had a warm relationship with company founder William Piper. In fact, it was Piper's indulgence of Conrad's grand schemes that got him into the business of flying seemingly impossible distances.

After his 1952 transatlantic flight, Max Conrad poses with the radio from his first crossing, and talisman Mickey.

But when Conrad first learned to fly in Indiana, almost nothing went right. At one point, according to his biography, Sally Buegeleisen's *Into the Wind: The Story of Max Conrad*, he decided that he could train himself better than any instructor could and never took another lesson. But his first few hours in the air led to one crash after another. The string of bad luck culminated in 1929, while Conrad was taking some youngsters aloft. After the flight, a young girl inexplicably climbed down off the wing and into the propeller. Conrad desperately tried to pull her away, but the girl was killed, and a propeller blade struck Conrad in the head, fracturing his skull.

He survived, but the damage to his brain was severe. He had difficulty reading, remembering, and even speaking. After a long convalescence, he returned to charter work and flight instruction. On Armistice Day of 1940, he flew a Piper Cub into the teeth of a sudden vicious Minnesota winter storm and located lost hunters. By 1942, he was operating five schools across Minnesota, each with its own fleet of aircraft. When he decided he simply couldn't manage the load, he moved all the aircraft to his headquarters in Winona. There, they were crammed tail to nose when some spilled gasoline caught fire and burned everything to the ground.

For once, Conrad saw the message in misfortune; he quit the flight school business for good. He flew as a bush pilot in Canada and then as chief pilot for Minneapolis Honeywell. But his long absences strained his marriage, and his wife Betty and their sizeable brood moved to Switzerland. She loved it, but Conrad missed his family and had a long chat with William Piper about an idea he had to put Piper airplanes on the map: He would fly a single-engine Piper Pacer across the Atlantic solo—and, in the bargain, get to see his family.

William Piper went for it, and now Conrad had to figure out how to get enough fuel and oil into the little airplane to extend its range. He pulled out the back seats and added extra gas tanks, a fairly easy modification. But for ultra-long legs the oil would have to be replaced. Knowing the rate at which the engine consumed oil, and inspired by the memory of the old gasoline heater on his father's farm, he contrived a system using air pressure to add engine oil to the crankcase in flight.

After completing the 1950 flight successfully, he upped the ante by flying to Paris nonstop and later delivered airplanes overseas, which turned out to be quite lucrative. But his longest flights were made in a Piper Twin Comanche, which he modified to carry 3,000 pounds of fuel. On takeoff, the airplane weighed almost twice its certified gross weight. He continued ferrying airplanes and setting distance records for many years, and always, when asked for his autograph, he signed it "*Let's Fly! Max Conrad.*"

GEORGE C. LARSON, MEMBER, NAA

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